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AUTOCLAVE SAFETY

According to the Massachusetts 105 Code of Massachusetts Regulations (CMR) 480.000: *Minimum Requirements for the Management or Disposal of Medical or Biological Waste*, all biologically contaminated waste must be disinfected prior to disposal. One commonly approved method for disinfection is the use of autoclaves, which utilize pressurized steam at extremely high temperatures to disinfect/sterilize certain materials.

Although autoclaves are quite efficient at processing most contaminated wastes, they also present several safety hazards to the user. The primary hazards include burns, fires, and explosions. Below are tips to help avoid autoclave incidents and accidents.

USE APPROVED CONTAINERS AND MATERIALS

Most metal containers or objects, Pyrex glass, Propylene containers, including bags, trays, and bins. When using propylene bags, place a small amount of water into the bag before autoclaving.

Waste paper, pipette tips, latex, and vinyl materials can be autoclaved in a biohazardous waste bag that is made for autoclaving. Ensure there is adequate moisture in the bag or add a small amount of water to ensure steam is created.

PROHIBITED MATERIALS

Using prohibited materials in autoclaves could result in fires and explosions!

- Solvents, volatiles, corrosives, flammables, combustibles, toxics, chemotherapeutic drugs, reactive materials, and radioactive materials are never to be used in an autoclave.
- Bleach solutions or liquid waste containing bleach (sodium hypochlorite).
- Oxidizing materials (such as dry hypochlorites) should never be autoclaved with organic materials (i.e., paper, cloth) as these materials combined with high heat could cause an explosion.
- Never allow any material or container to come in contact with the interior surfaces of the autoclave.

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GENERAL AUTOCLAVE SAFETY MEASURES

- All personnel using autoclaves must be properly trained. Training should involve a review of the operating instructions for each model that is used.
- Never exceed the maximum operating temperature and/or pressure of the equipment, and always select the appropriate cycle for the load.
- Always wear the appropriate personal protective equipment, including safety glasses and heat-resistant gloves.
- Autoclave bags should be placed in a secondary containment and never placed directly on the equipment floor.
- Loosely close bags and containers to allow some steam to escape.
- Liquid containers should be filled only half way, and caps should be loosened. To prevent explosion, never autoclave liquids in a closed container or bag.
- Allow materials in the autoclave to cool 15 – 20 minutes after opening and prior to removal.
- Never open the autoclave door until the pressure is at zero. When opening the door use caution by standing along the side of the equipment, and only open ½" to allow steam to escape before unloading.
- Never leave the autoclave in operation while unattended.
- Do not store combustible materials in the vicinity of an autoclave

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AUTOCLAVE CONTROLS

Autoclaves are complex machines that use pressure and steam to sterilize loads. Any run poses the potential for exposure to pressurized steam, superheated liquids, and heat stressed containers. Following the rules listed below will improve autoclave safety conditions in the laboratory, which should in turn reduce potential for employee accidents or injuries.

PREPARATION AND LOADING

- Inspect drain strainer daily, clean when blocked.
- Fill liquid containers no more than 50%-75% full.
- Loosen caps or use vented closures on bottles. (Never tighten caps on non-vented bottles.)
- Leave space between items to allow steam to circulate.
- **Never** use plastic bags, which are impervious to steam, unless the top of the bag is loosened to allow steam penetration.
- **Never** autoclave flammable liquids or explosive compounds.
- **Never** autoclave bleach due to the formation of acid gas upon contact with stainless steel. For liquid wastes that are first chemically disinfected, a suitable chemical disinfectant is Vesphene II, which can be autoclaved.
- Autoclave reusable syringes and needles in a pan of disinfectant.
- Do **NOT** autoclave cellulose nitrate media due to decomposition hazard.
- Place the load in secondary containment. Special autoclave bins or stainless steel bins can be purchased for this purpose. Secondary containment will serve to contain the broken vessels or ruptured bags that sometimes result from routine autoclaving.
- When a load to be decontaminated is comprised largely of dry materials in an autoclave bag, the addition of water to the bag may facilitate steam penetration. Although, it is important that caution be used so as not to create aerosols of infectious microorganisms.
- Recommend use of a biological indicator during each load.

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CYCLE SELECTION

- Use slow exhaust cycle when autoclaving liquids to prevent contents from boiling over.
- Select fast exhaust cycle for glassware.
- Use fast cycle and dry cycle for wrapped items.

TIME SELECTION

- Consider the volume of the material to be sterilized (a one-liter flask takes longer to sterilize than four 250-milliliter (ml) flasks).
- Materials with high insulating capacity (e.g., animal bedding, polypropylene containers) require an increased sterilization time.
- Process bags of biological waste for 60 minutes at 121C and 15 psi to ensure effectiveness of the sterilization. Some autoclaves operate at 132C and 27 psi. For these units times will be less. (See manufacturer's directions.)
- Process clean glassware, metal implements, or other equipment to be sterilized for 20-30 minutes at 121C and 15 psi. Some autoclaves operate at 132C and 27 psi. For these units times will be less. (See manufacturer's directions.)

BIOLOGICAL WASTE

- Use autoclavable bags.
- To prevent liquid spills and releases, place bags in a pan to transport to and from the autoclave.
- Use only autoclavable polypropylene or stainless steel pans.
- Close bags loosely to allow steam to enter.
- Process for 60 minutes at 121C and 15 psi for solid waste and 30 minutes at 121C and 15 psi for liquid waste.
- Routine monitoring should be conducted as part of an overall quality control (QC) program to determine the effectiveness of the autoclave. When decontaminating a load of biological waste, *Bacillus stearothermophilus* spores have been employed as a biological indicator. Place the biological indicator into the center of the waste by tying a string to the ampoule. Other commercial indicators are available such as steam reactive chemicals and colorimetric tape.

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REMOVING THE LOAD

- Check that chamber pressure is zero prior to removing the load.
- Wear a lab coat, face protection, heat-insulating gloves, and closed toe shoes to avoid steam exposures.
- Stand behind the door and open it slowly. Beware of a rush of steam.
- After slow exhaust cycle, open the door and allow liquids to cool before removing.

AUTOCLAVE/STEAM GENERATOR

- Read the owners manual and have it accessible to all users. Perform the daily and weekly maintenance procedures described in the manual.
- Electrically ground the unit.
- Post instrument operating instructions in close proximity to the autoclave.
- **Never** shut off the autoclave exhaust.
- Have periodic safety checks conducted by a qualified contractor on the unit. Check the safety valves, drain, door gaskets, interlocks, etc., at least annually, and more often if required by local regulations.
- Ensure that required boiler and/or pressure vessel inspections are done by your state agency/insurance company (if required).
- Do **NOT** stack combustible materials around the autoclave.
- Use biological indicators at least monthly to ensure that the autoclave is working properly. A study of monitored autoclave runs indicated that 15% were unsatisfactory. Maintain an autoclave notebook with results of all quality control (QC) tests and logged autoclaved waste.

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