

## Using Autoclaves Safely

Autoclaves are such a familiar feature in many laboratories that it is easy to forget what hazards they can pose. The autoclave's job is to render its contents sterile or free of any living organisms. If it fails to do so, serious health hazards can result. The hot, pressurized steam 270° Fahrenheit, 30 pounds per square inch pressure that autoclaves generate to do this job makes them serious burn hazards as well. In addition, because conditions created inside steam autoclaves are so extreme, autoclaves can easily malfunction if they are not carefully maintained.

**Before using any autoclave for the first time, read and thoroughly understand the owner's manual because many makes and models have unique characteristics.** If you cannot locate the manual, contact the manufacturer and have a copy sent to you.

### Modes of operation

The autoclave uses different patterns of high heat, vacuum, and pressure to sterilize its load. The type of materials you sterilize will determine the type of sterilization "runs" you use. The general types of runs are "liquids" for any type of water based solutions, "dry goods with vacuum," and "dry goods without vacuum." Autoclaves often have an additional "drying" cycle in which hot air is drawn through the chamber to dry materials before removal. Controls for different brands of autoclave vary, so you should carefully follow manufacturers' instructions about loading, load sizes, and cycle types and settings.

The "liquids" run is longer than the other two but uses lower temperatures to minimize evaporation of the liquids being sterilized. **Make sure seals on containers of liquids are loose so vapor expanding during heating will not cause an explosion. Never autoclave any flammable or volatile liquids because they could explode.**

The "dry goods with vacuum" run moves steam and heat into the deepest parts of large bags or bundles of materials and produces the best conditions for killing persistent organisms. During this type of run, the chamber alternates between cycles of vacuum and high pressure. Then the chamber is pressurized with steam for a long period, followed by a short vacuum cycle. It is important that steam and pressure be able reach the entire load, so carefully loosen autoclave bag closures once they are in the autoclave.

The "dry goods without vacuum" run simply pressurizes the chamber with steam for the duration of the cycle and then returns to normal. This process is used primarily for items that have been cleaned but need to be sterilized. Materials should be packed so that the heat and pressure can readily reach the whole load.

### Ensuring Thorough Sterilization

It is imperative to know that the autoclave has thoroughly sterilized its contents. Autoclave bags and tapes are usually imprinted with a dye that changes color when the correct temperature is reached. The problem with this type of check is that the dye is on the surface of the load, and a positive reading **does not ensure that the innermost parts of a large load are also sterile.** However, an easy way to check this is to wrap something with autoclave tape a disposable plastic test tube or pipette tip are possibilities, attach string to it, and put it deep into the load. Tape the other end of the string to the outside of the bag so that you can easily pull the indicator out. Do NOT open up a load of potentially infected material to bury something inside, however.) Recover the indicator after the run and confirm that it too has changed color.



## Routine maintenance

It is a good practice to use a biological indicator e.g., Amsco's Proof system, BBL's Kilit) monthly to confirm that the autoclave is working properly. If either the dye (see procedure above) or the biological indicator fails, you must examine the autoclave to identify and correct the problem. Then re autoclave the load to ensure sterility.

The best way to ensure that your autoclave is working properly is to have regular maintenance performed semi annually. In addition, users should perform the daily and weekly maintenance procedures described in the owner's manual. Also, make sure the drain strainer is clean before each run.

## Autoclave Safety

Autoclaves generate extreme heat and high pressure. Users should understand and respect the hazards these can create. Firmly lock autoclave doors and their gaskets in place before you run the autoclave to prevent a sudden release of high pressure steam. Most, **but not all**, autoclaves have safety interlocks that prevent the autoclave from running if the door isn't closed properly. Know if yours has an interlock. You'll need to use extra caution if it doesn't.

Some older autoclaves have little or no heat shielding around the outside. Attach signs warning of "Hot Surfaces, Keep Away" or similar wording on or next to the autoclave to remind people of the hazard. Do not stack or store combustible materials next to an autoclave (cardboard, plastic, volatile or flammable liquids).

When operating an autoclave, follow these procedures:

1. Be sure the autoclave or steamer is OFF before opening the door.
2. Be sure the steam pressure is down before opening the door.
3. Open the door slowly, keeping head, face, and hands away from the opening.
4. Wait at least 30 seconds after opening the door before reaching or looking into the autoclave/steamer.
5. Remove solutions from the autoclave slowly and gently; some solutions can boil over when moved or when exposed to room temperature.
6. Clean up any spills immediately.

Report any malfunctions or accidents immediately to your supervisor.

## Protective clothing

Use the following protective clothing when operating an autoclave:

1. Always wear long sleeved gloves designed for heat when using an autoclave or steamer. Do not use gloves that are wet or have holes.
2. Wear safety glass or goggles treated with anti fog.
3. When handling large volumes of liquid, wear rubber boots and a rubber or plastic apron that extends past the top of the boots.

If you are burned, you can receive treatment at the University Health Service's Tang Center at 2220 Bancroft Way. Burns to the face, third degree burns, or burns over large areas of the body should be treated as emergencies. Call 911 to get help. You can treat minor burns yourself by using the following first aid procedure:

1. Immerse the burn in cool water immediately. Do not wait for ice.
2. Remove clothing from the burn area.
3. Keep the injured area in cool water for at least 5 minutes longer is better.
4. Any burns to the face or eye or any burns that blister should be seen by a physician. Walk or drive to Tang Center on campus. Alta Bates Hospital also has emergency services.

Regardless of the degree of severity, report the burn to your supervisor or Principal Investigator as an occupational injury. If you have questions about autoclave operation or need help reaching a manufacturer, contact the Office of Environment, Health & Safety at 642 3073.

