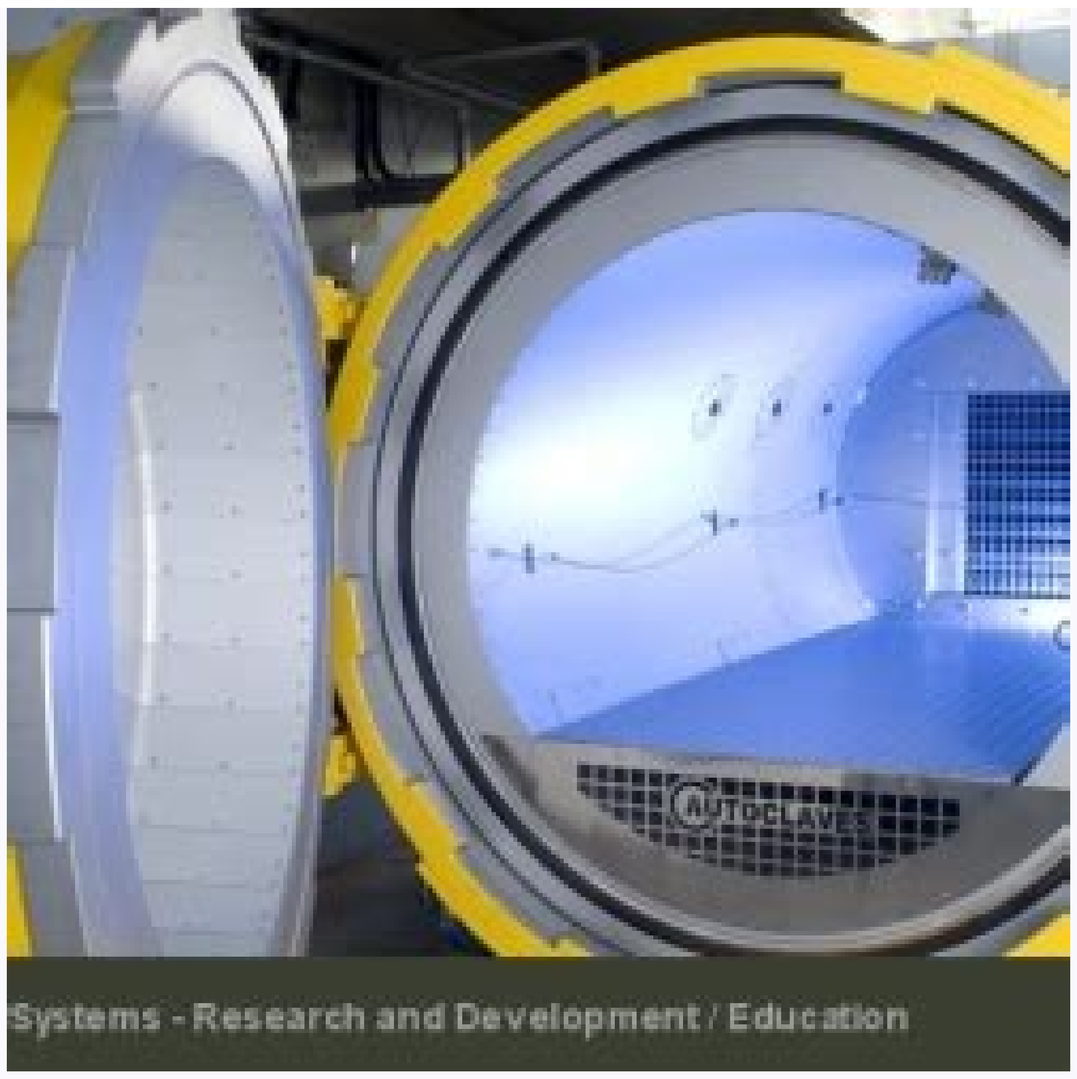
Autoclave user manual


AUTOCLAVES
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Privacy Overview This website uses cookies so that we can provide you with the best user experience possible. Cookie information is stored in your browser and performs functions such as recognising you when you return to our website and helping our team to understand which sections of the website you find most interesting and useful. Strictly Necessary Cookies Strictly Necessary Cookie should be enabled at all times so that we can save your preferences for cookie settings. If you disable this cookie, we will not be able to save your preferences. This means that every time you visit this website you will need to enable or disable cookies again. Steam sterilization is an important process, one that is performed in every laboratory. In this article, we will explore the history of steam sterilization, how a sterilizer works, and emerging trends in sterilizer design. Table of Contents An Introduction to Steam Sterilization Terminology The terms steam sterilizer and autoclave are synonymous and can be used interchangeably. That said, autoclave is often used in laboratory settings, while sterilizer is more commonly heard in hospitals or pharmaceutical settings. Autoclaves use steam heat to kill any microbial life that may be present on a contaminated load. A load — also known as goods — is considered sterile once it has undergone a full sterilization cycle. Once a load is sterile, it can be used without fear of introducing foreign microorganisms into a sensitive environment, such as a laboratory, hospital operating room, food production facility, and so on. Different types of goods must be sterilized for different lengths of time and at different temperatures. Some autoclaves include additional features, such as vacuum functions, special cycles, and integral electric boilers. History of the Autoclave Dr. Charles Chamberland invented the autoclave in 1879, but the concept of using steam in an enclosed space in order to prevent sickness has existed in some form or other since 1679. The principles and methods for sterilization have remained largely unchanged for the past 150 years. In fact, most major advancements in autoclave technology since 1879 have revolved around sterilization process monitoring, autoclave safety, and sterilization cycle creation rather than alterations to the sterilization process. Meet the People Behind Our Autoclaves >>> Why Steam? In order to kill a cell with heat, its temperature must be raised to a degree at which the proteins in the cell wall break down and coagulate. Steam is a very efficient medium for heat transference, which makes it an excellent way to destroy microbes. Air, on the other hand, is a very inefficient way to transfer heat/energy because of a concept known as the heat of vaporization. It requires 80 kilocalories (kcal) of heat energy to bring one liter of water to its boiling point (100˚C). It would require 540 kcal to convert that liter of water into steam, which means that steam at 100˚C contains seven times as much energy as water at 100˚C. That energy is what makes steam so much more efficient at destroying microorganisms. When steam encounters a cooler object, it condenses into water. Then, it transfers all of the energy that was used to boil the water directly into the water. This process heats up the cells far more efficiently than air at similar temperatures. This is why we use steam to achieve sterility. What is Sterility? Most people have a working understanding that sterile goods are free of microorganisms and are, therefore, safe to use in medical, food production, research or other settings in which the presence of germs would be a significant safety hazard or detriment. Exactly how many microorganisms will be left alive over time at a fixed temperature is expressed as a probabilistic logarithmic curve — a function that approaches but never reaches zero (see Figure 1). Figure 1 As the function approaches zero, one would typically choose a level of confidence — called the Sterility Assurance Level (SAL) — for the odds that the last microorganism present will survive. Contrary to popular belief, sterilization is not binary where something is either sterile or non-sterile. Sterilization is a statistical event characterized by this confidence factor (SAL) . The general standard for SAL is 10-6, or a one-in-a-million chance of a single viable microorganism surviving. How long sterilization takes depends on the set temperature and SAL level desired; higher temperatures will achieve sterility faster. How Does an Autoclave Work? General Process Whether it’s a small tabletop unit or a room-sized bulk unit, all autoclaves operate using principles similar to those of a common kitchen pressure cooker — that is, the door is locked to form a sealed chamber, and all air within that chamber is replaced by steam. The steam is then pressurized in order to bring it to the desired sterilization for the desired duration. Once the cycle is complete, the steam is exhausted, and goods can be removed. For a more detailed explanation of the various phases of a sterilization cycle, please refer to the list and image (Figure 2) shown below: 1. Purge Phase: Steam flows through the sterilizer and starts to displace the air; temperature and pressure ramp slightly to a continuous flow purge. 2. Exposure (Sterilization) Phase: During this phase, the autoclave’s control system is programmed to close the exhaust valve, thereby causing the interior temperature and pressure to increase to the desired setpoint. The program then maintains the desired temperature (dwells) until the desired time is reached. 3. Exhaust Phase: Pressure is released from the chamber through an exhaust valve and the interior is restored to an ambient pressure (though contents remain relatively hot). Figure 2 Critical Components of an Autoclave The typical laboratory autoclave is comprised of the following components (Figure 3): Figure 3 1. Vessel The vessel is the main body of the autoclave and consists of an inner chamber and an outer jacket. Laboratory and hospital autoclaves are constructed with “jacketed” chambers (see Figure 4), where the jacket is filled with steam, reducing the time that it takes to complete a sterilization cycle and reducing condensation within the chamber. A vessel designed and manufactured with a full jacket is superior to that of a partial jacket or blanketed jacket for the following reasons: a full jacket improves temperature uniformity within the chamber, it reduces the likelihood of wet packs, and helps minimize wet steam, which is not good for sterilization. [In the United States, every autoclave vessel is inspected and tagged with an American Society of Mechanical Engineers (ASME) nameplate that includes a National Board number. Manufacturers are required to hydrostatically test each vessel and apply an ASME nameplate before putting an autoclave into use. This inspection and the ASME nameplate are key indicators of a properly functioning autoclave. Laboratory and hospital autoclave vessels can vary in size, from 100L to 3,000L, and are typically constructed from 316L stainless steel. Inner chambers are either 316L or nickel-clad, and outer jackets are made of 316L, 304L stainless steel, or carbon steel. Figure 4 2. Control System All modern autoclaves are equipped with a controller interface, not unlike what you would find on a microwave or oven. That said, autoclave control systems tend to be a bit more sophisticated than those of household appliances. A sterilization cycle follows a preprogrammed software formula that opens and closes valves and other components in a specific sequence. Therefore, all autoclaves require some form of control system, whether it’s as simple as a “push button” system with a microprocessor or as complex as a programmable logic controller with color touch screen. 3. Thermostatic Trap All autoclaves feature some form of thermostatic trap or steam trap, a device designed to allow air and water (condensate) to escape from the chamber. Although a steam delivery system/steam autoclave might use a variety of traps, they all perform the same basic function: removing condensate while preventing the passage of dry steam. Most often, steam traps are temperature-sensitive valves that close when heated part a certain setpoint. Thermostatic traps are a critical component of any well-designed autoclave. 4. Safety Valve All autoclaves operate under elevated pressure (14–45 pound-force per square inch gauge) and must therefore be manufactured with an incredibly robust construction and fitted with a number of safety features and devices to ensure they present no danger to users. One of these safety devices is the safety valve, which is the final fail-safe device for the pressure vessel should all electronic controls fail. It is imperative that the safety valve be inspected, tested, and verified to be in proper working condition based on the recommendations of the sterilizer and/or valve manufacturer, as well as local inspection and insurance agencies. 5. Waste-Water Cooling Mechanism Many autoclaves are equipped with a system to cool effluent (air, steam, and condensate) before it enters the drain piping. Many municipalities and buildings do not allow effluent above 140˚F to enter the floor drain. In order to avoid damage to the facility’s drain piping, the steam must be cooled before it can be sent down the drawn. The simplest method for cooling this steam is to mix it with additional cold tap water, but the amount of water required can cause an autoclave to be a major contributor to a building’s water usage. Some autoclaves come equipped with systems designed to reduce, or even eliminate, water consumption. 6. Vacuum System (if applicable) In order to ensure proper sterilization, it’s vital that all air inside the autoclave chamber be replaced with steam. Certain commonly sterilized goods — especially porous materials such as animal bedding or cloth or containers with small opening such as flasks or goods in bags — tend to retain air pockets. If an air pocket is present during the cycle, any microorganisms within that pocket will survive, and the goods will not be sterile. For this reason, many sterilizers will include a vacuum system. This not only enables the user to forcibly remove air by using a vacuum on the chamber before a cycle (known as pre-vacuum), is also enables them to use a vacuum after the cycle (known as post-vacuum) to remove any steam that remains in the chamber and to dry off the goods inside the autoclave. 7. Steam Generator (if applicable) A central “house” boiler is the most common steam source for an autoclave. However, if house steam is unavailable or insufficient for the autoclave, one must resort to using an electric steam generator, also known as a boiler. These boilers typically sit underneath the autoclave chamber and utilize electric heating elements to heat water and generate steam. Need Help Choosing a Steam Source for Your Autoclave? Check This Out >>> To learn more about autoclaves, check out our video here: Sterilization Cycles There are, in general, four standard sterilization cycles: gravity, pre-vacuum, liquids, and flash (also known as immediate use). The chart shown below explains these cycles in greater detail. Some autoclaves also have the ability to perform specialty cycles designed to avoid damage to delicate goods that need to be sterilized but would be damaged or destroyed by the rapid changes in temperature and pressure in a normal cycle. These specialty cycles include much longer cycles at lower temperatures, steam-air mix cycles with special pressure controls to avoid breaking sealed test tubes, and cycles that us special instrumentation to ensure full sterilization temperature is achieved. Here’s What You Need to Know About Steam Sterilization Cycles >>> Emerging Autoclave Trends Autoclaves may be considered ancient devices by the standards of modern science, but this does not mean that autoclaves lack innovation, especially when it comes to controls, cloud connectivity, and ecological impact. As mentioned earlier, autoclave controls have advanced greatly in the age of computers, progressing from manual controls and simple timers to computer automation that minimizes or eliminates entirely the need for user input. Computerized controls have also led to advances in data control, record keeping, and remote monitoring via mobile devices. Autoclaves with automatic printers that record data for the purpose of verifying successful sterilization have now been replaced by new autoclaves that connect to the cloud to store cycle records on the internet. Another trend in autoclave design is sustainability. Autoclaves are a major source of water and energy consumption, both in laboratories and hospital; in recognition of this, many manufacturers have found innovative ways to reduce autoclaves’ environmental impact. Green autoclaves that reduce or even fully recycle the water consumed by a sterilizer — in some cases, from 1,500 gallons a day to less than one gallon a day — are critical to create an environmentally friendly laboratory. Control systems that automatically turn the autoclave when not in use can also significantly reduce energy use — in some cases, from 80 kilowatt-hours per day to 20 kilowatt-hours per day. Your Go-To Source for All Things Autoclave-Related Whether you’re using an autoclave to sterilize medical or laboratory equipment, it’s important that you develop a keen understanding of the sterilization process — both how it works today and how it is changing. Ask These Key Questions Before Buying Your Next Autoclave >>> Consolidated Sterilizer Systems has a rich heritage in the steam sterilization industry, with over 75 years of experience. We strive to deliver manufacturing excellence and are committed to supplying high quality, high performance sterilization and distillation solutions. If you’re interested in learning more about the steam sterilization process, or have other autoclave-related questions, contact us today. 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