



CONSOLIDATED
STERILIZER SYSTEMS

17 QUESTIONS TO ASK BEFORE BUYING YOUR NEXT AUTOCLAVE



When you're in the market for an autoclave, the purchasing process can feel overwhelming.

With so many models, sizes, options and components to choose from, how can you ever really know exactly what you need to make the most out of your investment? If you aren't sure, don't worry—you aren't alone.

We created this 17-question eBook as a framework to help you explore and discover the exact type of autoclave best suited to your needs. These questions will help you to make informed decisions by outlining what is most important to consider and know about owning an autoclave.

Let's get started!

1 ■ What size autoclave do I need?

Determining the right size autoclave for your laboratory depends on two things:

- A. The size and quantity of your load and**
- B. The available space in your lab.**

In other words, throughput capacity dictates the size autoclave you need, while floor space determines what you can actually accommodate. Common sizes range from tabletop autoclaves to small, medium, and large (bulk) autoclaves.

Tabletop autoclaves tend to be inexpensive units that are ideal for a very limited audience, i.e., those concerned with sterilizing only small, basic equipment, such as dental practices or tattoo shops.

Small, medium, and large bulk autoclaves are more appropriate options for clinical, animal, life science, biotechnology, pharmaceutical, commercial, industrial, and medical research applications. Often called laboratory autoclaves, these chambers have an internal volume capacity ranging from 2 cubic feet to upwards of 200 cubic feet and boast a variety of configurations, from single door, gravity units to vacuum walk-in autoclaves.

To determine the size autoclave that best suits your needs:

- 1.** Know the volume and size of your average loads and compare that to the published chamber dimensions and volume capacities of autoclave models.
- 2.** Think about how the load will be configured and loaded into the autoclave. For instance, are you sterilizing stacked rodent cages, multiple trays of glassware, or bedding? Will you place it on a standard oven-style shelf in the autoclave, or will you require a loading cart and transfer carriage for easier mobility. Analyze different material handling options that will match your needs and be aware of how an autoclave will meet these needs and leverage cubic space most effectively.
- 3.** Measure the floor space available and compare this to the footprint of the autoclave. Know that you will require additional space around each side of the unit for service clearance. If you have limited space, ask the manufacturer to customize your autoclave so that all of the plumbing is mounted on just one side of the unit.

2 ■

What types of loads will I be running in my autoclave?

The autoclave you purchase should possess the cycles capable of sterilizing your specific loads

(e.g. media, glassware, redbags, etc.). Be sure to inquire about which cycles your autoclave is capable of running and ensure your desired materials can be properly sterilized.

Consult the table below for common load types and their corresponding cycles.

Once you’ve identified the Cycle Types that fit your application, you can select between two types of autoclaves: pre-vac and gravity.

1. Gravity autoclaves are ideal for sterilization of non-porous goods and liquids.

2. Pre-vac autoclaves efficiently remove air from the chamber and the load allowing steam to completely penetrate the products being sterilized, such as porous goods, and allow for validation test cycles.

Table 1: Common Load and Cycle Types	
Typical Application or Load Type	Basic Cycle Type
Glassware, unwrapped goods, waste, utensils, redbags.	Gravity
Wrapped goods, packs, animal cage bedding, cages, porous materials.	Pre-Vacuum and/or Post-Vacuum
Media, LB broth, water.	Liquids
Unwrapped goods	Flash (Healthcare sterilizers only)
Typical Application or Load Type	Advanced Cycles
BSL-3 contaminated goods such as waste, liquids and other	Effluent Decontamination
Insipitation or Pasteurization of heat-sensitive goods (180°F – 220°F)	Low Temperature
Small quantities of liquids (<10ml/vial)	Air-Over-Pressure
Heat-sensitive media and liquids	F0 Cycle
Daily air removal test, typically for healthcare applications	Validation, Bowie-Dick Test
Tests for air-tight integrity of chamber	Validation, Vacuum Leak Test

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■ What is my steam source for the autoclave?

Many facilities have “house steam” available to supply their autoclaves.

If house steam at 50 psi and 80-300 lbs/hr is not available, you will require an electric steam generator (a.k.a. boiler) to create the steam necessary to sterilize your loads. Boilers can be purchased with your new autoclave or retrofitted to an existing autoclave. They are typically available in 208, 240, 380, and 480 voltages and in single or three-phase connections, with capacities ranging from 20kW to 120kW. “Automatic blow-down” is an option available for generators that will help extend the life of your heating elements by flushing away minerals left behind from the feed water source.



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Do I have the right type of water available for the autoclave?

Water is the lifeblood of any autoclave

and its quality can drastically impact the lifespan of the autoclave's components, steam generator, and even the chamber. Water quality also dictates the types of loads that can be sterilized. For example, water with a quality of $>1 \text{ M}\Omega/\text{cm}$ is pure enough to sterilize items for a tissue culture lab. The quality of water is often defined by its levels of hardness, minerals, chlorides, and so forth. Common water sources are:

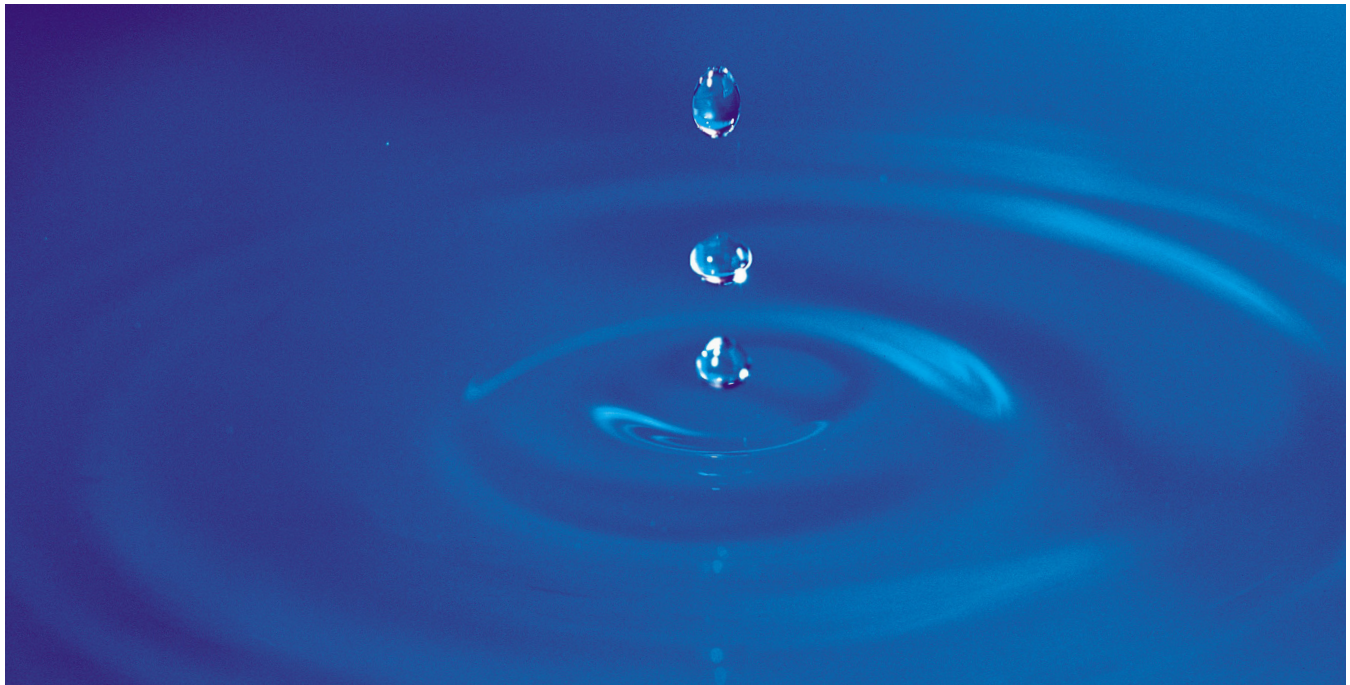
Tap Water. Many laboratories use a domestic cold water supply to feed their autoclave, but this practice can lead to costly downtime and expensive repairs if the quality is not adequate.

Be aware: Tap water contains a variety of dissolved minerals and salts depending on your geographical location and water source (ground well, lake, river, etc.). The more minerals the water contains, the "harder" it is. Hard water can be problematic. When hard water is boiled into pressurized steam or used to cool autoclave waste, it leaves behind mineral deposits on the unit's generator, pipes, and valves. Like layers of paint, these deposits build up over time and decrease the efficiency and functionality of the unit. Water that is harder than 5 grains (85 mg/L) should be treated (reference table #2). Your local municipal sewage report will indicate the hardness of your tap water.

Water Quality Specifics

Water between $0.1 \text{ M}\Omega/\text{cm}$ to $1.0 \text{ M}\Omega/\text{cm}$ (purity achieved with a Type III RO filter) is appropriate for the vast majority of research lab sterilizer loads such as bio-hazardous waste, clothing, cages, glassware, media, or general lab equipment. Water $>1 \text{ M}\Omega/\text{cm}$ is appropriate for items very sensitive to mineral contamination, such as tissue samples or items used in cGMP processes. Water of this purity is generally only achieved from RO/DI or distillation purification.





Purified Water. There are three common methods to remove impurities from tap water that is too hard:

- Softened Water: removes most hardness from water
- Reverse Osmosis (RO): removes most solid contaminants and dissolved minerals and hardness
- Reverse Osmosis/Deionization (RO/DI): removes most solid contaminants, minerals, and ions

Note: Keep in mind, when high purity water (> 1 MΩ/cm) is used as the source for steam generation, the autoclave must to be constructed from stainless steel, specifically the chamber, jacket, steam generator and process piping. High purity water lacks ions or minerals and will try to leach impurities from everything it touches, including glass, steel, and copper. This could cause continuous corrosion and premature failure of non-stainless steel components.

Table 2: Water Feed Requirements, Carbon Steel Steam Generators

	Recommended Conditions	Max Conditions
Temperature	As Supplied	140°F (60°C)
Total Hardness	0-17 mg/L	85 mg/L
Alkalinity	50-180 mg/L	350 mg/L
Total Dissolved Solids	0-150 mg/L	250 mg/L
pH	7.5-8.5	7.5-9.0
Total Silica	0.1-1.0 mg/L	2.5 mg/L
Resistivity	2,000-6,000 Ω/cm	26,000 Ω/cm

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■ How much floor-space will my unit take up?

Every autoclave requires devoted floor-space in a facility

To maximize your floor space, know how many autoclaves you will be housing and each autoclave's physical footprint, as well as:

Installation Type

Will you be seeking a cabinet or recessed installation? If the unit is going to be placed into a wall or an existing opening, the opening may need to be increased in size to accept the autoclave. Just the same, trim panels may need to be fitted to fill any gaps in an opening that is too large. In either case, plan to have 12-24" of additional space on the sides and back of the autoclave to allow for the dissipation of heat and room for servicing the unit.

Door Configuration

Does the door slide vertically or open outward on hinge? Is the hinge located on the left, or on the right? Identify if you have space for a door to swing open, and if you do, which way you want the door to swing. Make certain this will not interrupt your current lab layout, i.e., tables, counters, chairs, or other equipment. You never want your autoclave to be competing for space, as this can interrupt workflow and other lab operations.

Plumbing Configuration

Where is the plumbing connected? Is it at the back of the unit, or on the side? Plumbing connected through the back of the unit requires additional room in the back, and can create more difficulty for maintenance, repairs, or troubleshooting. Know where you can afford more space (in the back or the side of the autoclave).

The right manufacturer will customize your autoclave specifications to meet your exact needs and save your lab space. For example, a manufacturer could configure your unit to have all of the plumbing on one-side so that the "non-plumbing" side could rest closely to a wall.



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■ What utilities are required?

To prepare for installation,

verify you have the proper utility sources available within 5 feet of your unit:



Water

A water source with a minimum of a ¾" water line capable of providing 45 PSI dynamic pressure with a flow of 12 gallons/minute is required for effluent cooling, steam generation (if applicable), and operating the vacuum system (if applicable.)



Steam

To sterilize any equipment, you need to convert a water source into a steam source. This can be accomplished by 1) using house supplied steam with 50-80 PSI dynamic steam pressure with a ¾" NPT connection, or by 2) purchasing an electric steam generator add-on with your autoclave. Generators are typically available in 208, 240, 380, and 480 voltages and in single or three-phase connections.



Electricity

Whether you use a steam generator or have house-supplied steam, your autoclave needs electricity to operate. The requirements are: 110V, AC or 220V, AC, 1-phase, 15 amps—dedicated and isolated.



Drainage

Though not a utility by definition, you must have an appropriate drainage source within 5 feet of your autoclave. A typical waste connection requires a 2.5" air gap over a 2.5" gravity floor drain



Should I invest in water and energy saving technology?

Traditional autoclaves consume an enormous amount of water.

For example, one small to medium autoclave can consume upwards of 1 million gallons of water per year. The water is used for 3 purposes:

Steam Generation | Effluent Cooling | Vacuum Generation

In a standard autoclave, the steam generation process only requires 30-50 gallons/day, but the effluent cooling and vacuum generation can use between 10 and 50 times more water per day! A majority of the consumption is used for cooling hot effluent (to below 140°F) before it is drained, as required by most local building codes.

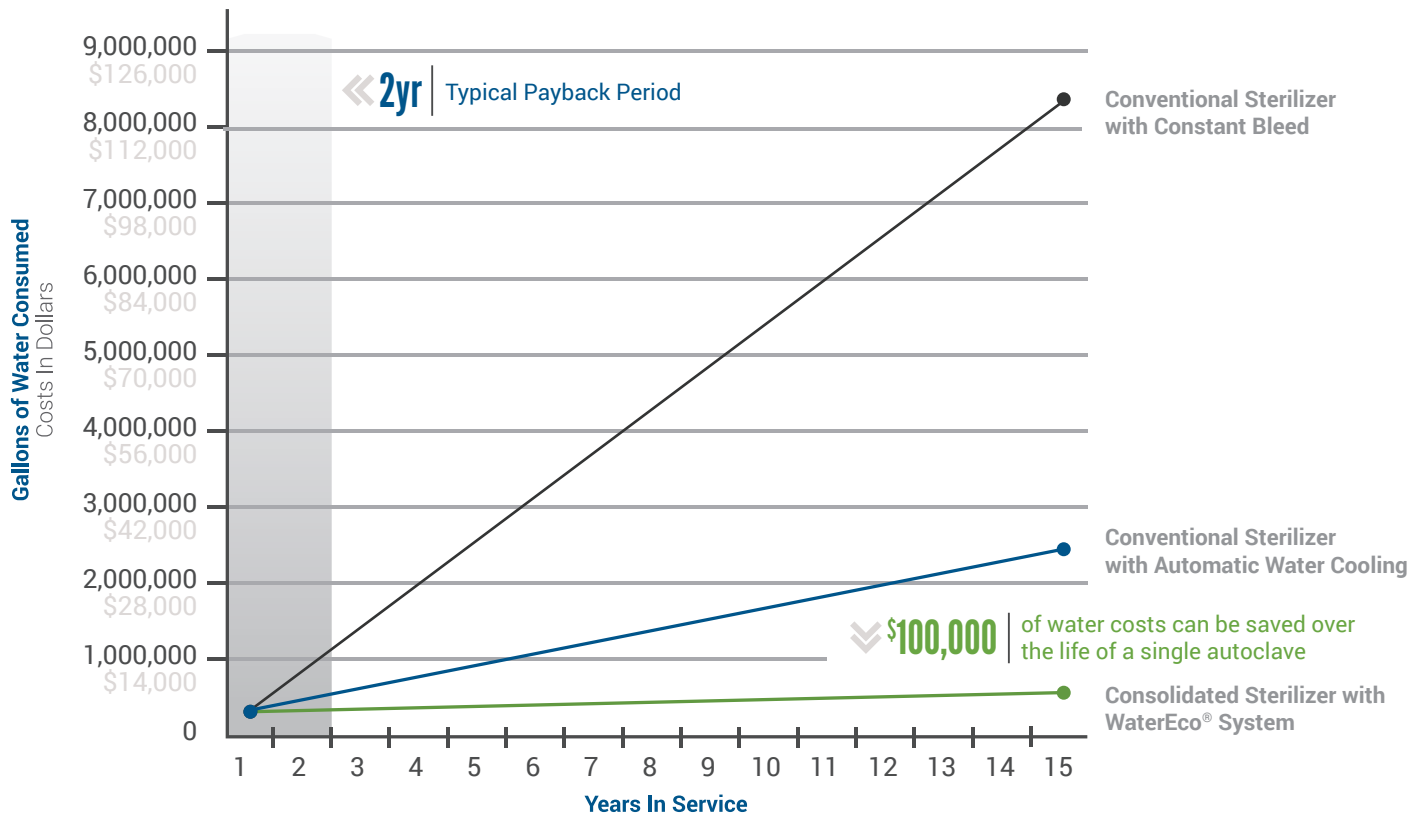
To combat effluent cooling and vacuum generation inefficiencies, as well as to achieve LEED certification and ASHRAE compliancy, some autoclave manufacturers now offer optional water-saving technologies that:

- 1. Reduces water usage by up to 99%**
- 2. Reduces the average water bill by more than \$8,000/yr.**

Water usage improvements are a direct result of efficiency technologies, such as:

- 1. Removal of or modifications to constant-bleed designs associated with effluent cooling**
- 2. Using facility-chilled water loops to cool the waste steam and condensate**
- 3. Employing recirculation systems which pump water back to the vacuum system**

Note: Every solution or improvement does require some design consideration and associated upfront costs to initiate, but **the right manufacturer will be well versed in these solutions and the ROI is traditionally realized in 1-3 years.**



In addition to the above options, you can reduce energy and water consumption by simply turning your autoclave off. This is a zero cost and minimal effort approach to noticeably reduce water consumption, eliminating the need for the system to continually work to maintain the right warm temperature needed for sterilization. Turning your autoclave off after the workday can save up to 70% of the effluent cooling water typically consumed. Some manufacturers now offer an automatic shut-off feature that turns the autoclave off when not in use (otherwise known as “night and weekend set-back”).

8. How will I get the autoclave from the loading dock to its final resting place?

Remember—no matter how much or how little physical space you have—installing or removing autoclaves can be challenging due to structural obstacles, odd loading dock dimensions, narrow hallways, stairs, doorways, or floor-weight restrictions. Consider how you will receive your autoclave and move it into position. Proper planning and measurements can help avoid costly, disruptive rigging and renovations, such as knocking down existing walls or employing cranes to hoist equipment to high-level floors.

9. Is tech support available?

No one anticipates downtime, but when your autoclave isn't functioning properly, you want to be sure that competent tech support can be provided quickly. Downtime is costly both financially and for your lab's productivity. Inquire with your manufacturer about who provides technical support and when it is available. Do they outsource to a call center or provide competent in-house expertise? Also, is help available during your operating hours?

Evaluate who will service the autoclave should it need actual repairs and replacement parts, and be sure that the service company is factory-trained and available for same-day calls. A reliable local service company should be stocked with commonly needed replacement parts.

10. What is the warranty?

Manufacturers should provide a minimum warranty of 1-year on parts and labor and at least 10 years on the autoclave pressure vessel.

As stated above, evaluate who will service the autoclave should it need actual repairs and replacement parts.



11. Are the replacement parts proprietary or commonly available?

Autoclaves typically last for over 20 years, so it is in your best interest that the autoclave you purchase is manufactured with non-proprietary parts—this is truly a way to protect your investment.

Non-proprietary parts ensure that parts procurement will always be readily available and inexpensive when future replacements are necessary. Should a manufacturer be out of stock, difficult to deal with, or go out of business altogether, you want to know you can get what you need, and not feel “stuck” with their equipment and no one to help. Your lab’s overall production can be drastically hindered by a proprietary parts dilemma.

12. Are preventative maintenance plans available?

The simplest way to prevent downtime is by having regularly scheduled preventative maintenance visits. A manufacturer should help devise a plan for service based upon usage and throughput.

13. Is training available?

Quality training and education is essential for establishing best practices among end-users. Beyond installation and start-up training, inquire if your manufacturer provides training for cycle set-ups, advanced cycles, troubleshooting tips, and calibration techniques. Properly trained end-users and facility technicians will help prevent downtime later on.



14. ■ Where is the sterilizer manufactured?

In today's U.S. market, there are both domestic and foreign autoclave manufacturers

and just like your car or your food, it's important to know where your autoclave comes from. Where a unit is manufactured can impact the overall value. The question becomes: Do I buy a U.S. or foreign made autoclave?

If you are a U.S.-based organization, autoclaves engineered and manufactured in the United States can provide more returns than their foreign counterparts. Here are several factors to consider:

Quality & Craftsmanship

Plenty of foreign autoclave manufacturers are capable of manufacturing durable machines, but some outsource their operations to facilities less or completely unfamiliar with autoclave fabrication. Over the life of your autoclave, this can lead to part failures and overall integrity compromises—meaning your investment is worth far less than the dollar price you pay for it. Be sure to inquire about the origin of manufacture for both the pressure vessel and final assembly, and be mindful that many autoclave manufacturers boast a “U.S.-based headquarters” (where they assemble products), but actual fabrication takes place elsewhere.

Lead Time on New Orders & Replacement Parts

Foreign autoclave manufacturers cannot deliver autoclaves as quickly as a U.S. manufacturer can, and likewise cannot fill future orders for parts as quickly. Consider the complications and increased lead-times associated with international shipping policies, rules, and regulations. Each of these challenges ultimately leads to more waiting and more downtime than your lab has time for. Ask about lead-time before making a purchase.

Service & Support

When you buy an autoclave, you are also buying the service and support that comes with your unit. With a foreign autoclave manufacturer, this experience can be more stressful to navigate. From initial inquiries to installation to training to scheduling maintenance or emergency repair visits, every service request can become overly complicated by an international relationship where hours, availability, and expectations of service and support may not align with your needs and expectations. This can increase downtime and leave you feeling isolated throughout the lifetime of ownership. Ask who will service and repair your equipment and if they are factory-trained.

Support for the U.S. Economy

As it stands, manufacturing contributes nearly \$2 trillion dollars to the U.S. economy annually. The U.S. manufacturing industry accounts for the world's 10th largest economy according to the National Association of Manufacturers. So, buying domestically manufactured autoclaves helps supply these jobs and maintains America's prominence in the global economy. On the contrary, buying overseas does not support this goal, and similarly does not meet requirements of the American Recovery and Reinvestment Act of 2009 (ARRA) or the Buy-American Act, formally known as 41 U.S.C 101, each designed to encourage U.S. manufacturing that uses materials produced substantially in the United States. This can be significant for accounts/facilities/labs that are funded by monies allocated to "buy American." Ask your purchasing department about these Acts.

15. How many years has the autoclave manufacturer been in business?

There is true value in working with an autoclave manufacturer that has withstood the test of time. Seek out a manufacturer with many years of experience and a rich heritage of working with well-known and respected universities and research hospitals. To truly gauge credibility, quality, and reliability, ask for references and follow up with each. The more references you receive, the better.

16. Does the manufacturer have a single-product focus?

You want to work with a manufacturer with a single product focus. Single product focus allows a manufacturer to build the most reliable, affordable, and customizable autoclaves. Such strict focus also means engineering, production, and customer service efficiencies are increased—and the customer reaps the immediate and long-term cost benefits of this manufacturing approach. While it is not uncommon for autoclave manufacturers to manufacture other lab equipment, it does mean their efforts can be divided by a fragmented manufacturing process and incentivized cross selling.



17.

Do I want to purchase a new or refurbished autoclave?

Because an autoclave can last up to 30 years, the benefits and payback of purchasing a new unit outweigh those of a used unit.

That said, used or refurbished autoclaves are a great option for price-sensitive customers. In this case, purchasing one from a respected manufacturer can help you adhere to a stricter budget, without compromising performance, reliability, and safety.

When evaluating a new versus a used autoclave, consider the following:

Warranty: The warranty coverage and period on a new unit is typically very comprehensive. The warranty on a new unit will generally cover parts and labor for one or more years. Used autoclaves may be sold “as-is” or may have a very limited scope of warranty coverage.

Vendor: The company selling the autoclave should be certified by the American Society of Mechanical Engineers (ASME) and should possess an ASME R-stamp.

Chamber:

Ask if the chamber has been hydro-tested for leaks.

This is a process that is recommended by the ASME before sending a refurbished unit back in the field. All modified refurbished chambers should come with an R-stamp on the ASME name plate.

Ask to see photos of the interior portion of the chamber.

Keep an eye out for severe degradation and corrosion that could jeopardize your investment.



Components: Request to have brand new components (valves, plumbing, and electrical components) installed on the refurbished unit. Also ask about the controller – is it new or used? Parts that are not new will have a decreased service life. Frequent failures caused by worn out parts can lead to expensive and frustrating down-time. Additionally, it is important to ensure that all of the parts on the sterilizer are still available for purchase at a reasonable price.

Support: All equipment will eventually experience some sort of issue. When this happens, is a local and knowledgeable technician available to assist with the repair.

Whether buying new or used, your ultimate goal should be to work directly with an experienced manufacturer who sells both new and refurbished equipment. A manufacturer who produces new equipment can leverage their existing product knowledge and resources to lower the lifetime cost and frustration of a refurbished autoclave. Some areas of benefit are:

- A used model will likely be refurbished with higher quality parts and superior craftsmanship due to more experience and a better skilled workforce. A manufacturer will employ engineers and fabricators who are constantly working to keep everything they sell reliable and competitive.
- Service and support is likely better when dealing directly with a manufacturer. Additionally, a manufacturer will comprehensively test a sterilizer prior to shipment. Because of this extra testing and confidence in the autoclave, a manufacturer will typically offer a better warranty.
- A used model will likely be refurbished with brand new parts, controls and the newest release of operating software.
- A manufacturer will have the capabilities and knowledge to customize or enhance a refurbished autoclave to suit customer specific needs such as space, utility or service constraints.



So, now you know!

For reference, the 17 questions are below—yours to ask before buying your next autoclave. We hope these questions will serve you and your laboratory well for years to come!

1. What size autoclave do I need?
2. What types of loads will I be running in my autoclave?
3. What is my steam source for the autoclave?
4. Do I have the right type of water available for the autoclave?
5. How much floor-space will my unit take up?
6. What utilities are required?
7. Should I invest in water and energy saving technology?
8. How will I get the autoclave from the loading dock to its final resting place?
9. Is tech support available?
10. What is the warranty?
11. Are the replacement parts proprietary or commonly available?
12. Are preventative maintenance plans available?
13. Is training available?
14. Where is the sterilizer manufactured?
15. How many years has the autoclave manufacturer been in business?
16. Does the manufacturer have a single-product focus?
17. Do I want to purchase a new or refurbished autoclave?



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