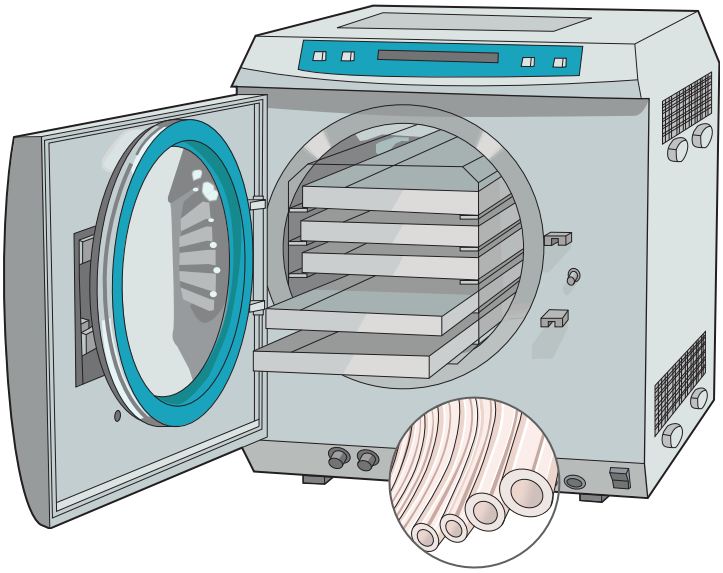
Priorclave North America

"Economical" Tabletop Autoclaves: Priced To Sell, Not Built To Last

Ever wonder why you're replacing your sterilizer every 2 to 5 years?

In order to meet increasing demand from US research and university labs, established medical-grade autoclave manufacturers now offer a variety of "economical" tabletop sterilizers. Unfortunately, when set to common research tasks (liquid sterilization, growth media prep, and waste processing) these units fall short. They quickly become unreliable, and are often irreparable in under five years. By comparison, designated research-grade autoclaves continue reliable operation for 20 years or more.

ANATOMY OF AN "ECONOMICAL" TABLETOP AUTOCLAVE



To understand why these "economical" tabletop sterilizers fail so quickly in laboratory settings, it's necessary to understand their purpose and design.

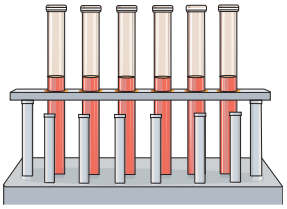
Economical tabletop autoclaves are essentially medical devices: Originally built for dental offices and small medical clinics, they're designed to take clean medical instruments and sterilize them for immediate use. They need to complete cycles relatively quickly and produce a load that's dry when the door releases. In order to accomplish this, they rely on relatively thin steel sterilization chambers that heat and cool quickly, often creating a vacuum in the chamber. This is advantageous if you need to quickly dry a load. (Some models even enhance this effect with an additional vacuum pump, to evaporate surface water off of instruments as quickly as possible.)

Because they are designed for cost-conscious customers who are running clean loads that simply need to be rendered sterile, the plumbing and valves in these sterilizers are narrow, and the filters very fine. Tabletop dental sterilizers further contain costs by eliminating external plumbing: The internal water reservoir is periodically manually filled by the operator (similar to a coffee maker).

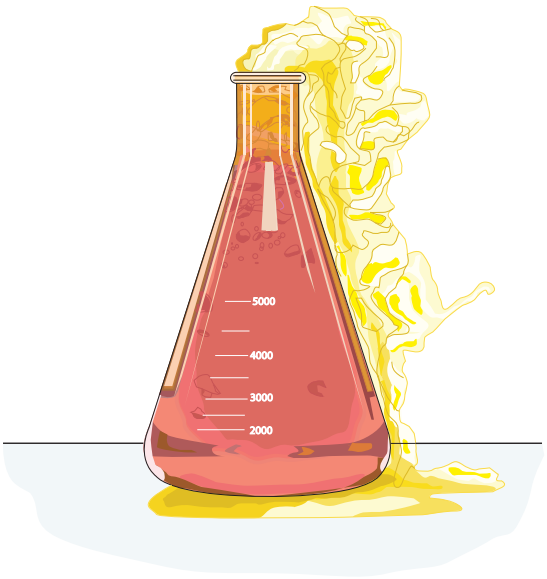
In order to save water, many non-research autoclaves recapture the steam used for sterilization, cool it, and collect it to be reheated for the next sterilization cycle.

Low-cost tabletop sterilizer control systems tend to be minimal and focused on factory-set, verified cycles well within the parameters regulated for medical use by the FDA. This is an excellent design if you need to take clean instruments and quickly render them sterile and dry. But these same design features handicap the processing of liquids, waste loads, or any load that is likely to contain large concentrations of viable pathogens.

THE PROBLEMS OF LIQUID LOADS

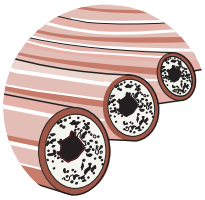


Liquid loads are tricky. For example, without fairly fine control of either temperature ramp-up/ramp-down or chamber pressure, it's challenging to sterilize high-glucose growth media without accidentally caramelizing it. Regardless of what the brochures say, "economical" tabletop sterilizer control systems are rarely precise or accurate enough to reliably handle anything but the simplest liquid load, and even those can be botched.



Part of the problem is that dental sterilizers tend to decrease chamber pressure during operation. Reducing the pressure in the chamber lowers the boiling point of fluids in the chamber, speeding evaporation. It's the surest way to safely produce dry loads. But encouraging evaporation is obviously a problem if you put a test tube with 10 ml of liquid in your sterilizer and intend for it to come out with 10 ml still in it. **It's not unusual for a tabletop sterilizer operating in this manner to evaporate up to 25 percent of a liquid load.**

Even worse, low pressure sterilization greatly increases the likelihood of flask rupture or boil-over, especially when preparing growth media. This doesn't just result in the inconvenience of lost media and wasted time. When loads rupture or boil over, it's highly likely that the recirculated water in the chamber will become fouled, clogging the sterilizer's filters and narrow-bore plumbing. This drastically reduces the unit's operational lifespan.



Even on models that allow you to selectively disable any built-in vacuum pump, unless the control system is also designed to ramp the chamber exhaust rate to match the rate at which the chamber cools, pressure will dip too quickly. This increases evaporation and the incidence of boil-over and rupture. In contrast, true research-grade autoclaves—those optimized for laboratory tasks like liquid and media prep—maintain, or even increase chamber pressure, in order to ensure thorough sterilization without risk of boil-over or excessive evaporation.

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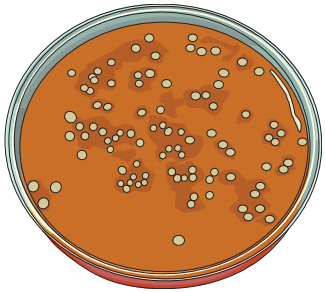
THE HAZARDS OF WASTE STERILIZATION

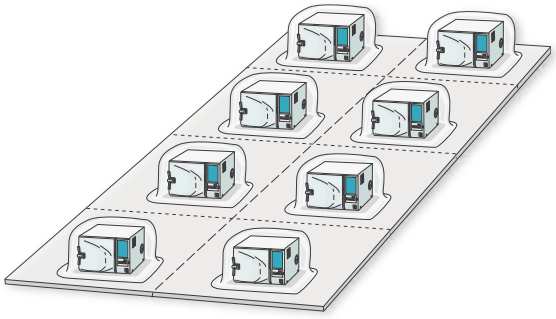
The problems posed for liquid loads are compounded for waste loads: Evaporating the liquid in a waste load doesn't just mean the inconvenience of lost growth media, diluent, or buffer. It also means baking any solids in the waste load onto the otherwise reusable glassware or instruments. If you suffer a rupture or boil-over while processing waste, both viscous liquids and solids can be drawn into the sterilizer's plumbing, clogging pipes, valves, and filters. Low-cost tabletop models are not particularly designed for ease-of-service, which is why regular waste-load processing can shorten the lifespan of an "economical" tabletop autoclave to just 24 months.

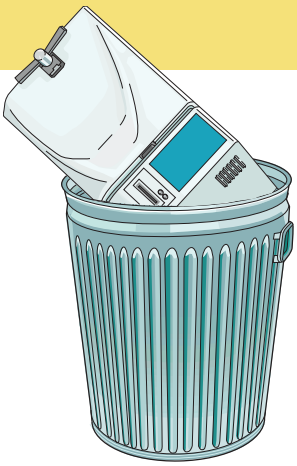
Using a dental-style tabletop autoclave for waste disposal can also create potentially serious public health hazards. Some low-cost tabletop sterilizers feature recirculating water systems that pump waste steam back into the fresh water reservoir.

Recall that, by design, dental tabletop sterilizers are intended for clean loads in need of simple sterilization, not dirty loads harboring high-concentrations of pathogens. If you're processing only "clean" loads—that is, ones with very low likelihood of significant biological material—then recirculating the water supply won't cause problems: Whatever trace number of pathogens aren't entirely killed in the autoclaving process will be diluted into insignificance in the chamber. But many waste loads are being processed specifically because they have been infected with dangerously high concentrations of microbes. If such a load were to boil-over and infiltrate the sterilizer's reservoir, it could prove an excellent breeding ground for bacterial colonies.



Such a scenario may seem far-fetched, but chamber drain discharge from make-safe procedures—like waste load processing—regularly contains viable microorganisms. For that reason "recirculation" recovery schemes are not legal in the European Union.





On paper "economical" tabletop sterilizers seem like a terrific deal: cheap, quick to install, "easy-to-use" autoclaves with a small footprint. Unfortunately, over time, these units prove unreliable in completing common research tasks, resulting in bad loads, lost hours, maintenance hassles, and strained budgets. They are priced to sell, not built to last.

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CAVEAT EMPTOR!

Worried that the sterilizer you're looking at is a medical or dental autoclave being marketed for laboratory use? Look for these red flags in brochures and other marketing materials:

- Drying: Beware of phrases like "fast drying" and "thorough drying," or features like "auto dry" or an "active drying system." These usually mean the chamber will be depressurized at some point in the cycle.
- Pre-set programs: If there is an emphasis on factory-set programs (possibly to the exclusion of any user-defined cycles) you will likely be restricted to cycles most useful in a medical clinic. Look for phrases like "fixed cycles" or "X pre-set programs."
- "Self-contained": This very likely means that the sterilizer has no drain or fresh water inlet. It's likely unacceptable for most waste processing. Beware of "autofill" units that also tout being "no drain" or "require no plumbing." Also look out for "recirculation" and "steam recirculation."

- Medical terminology: Especially mentions of "dental instruments" or "clinics." If the brochure says the unit is FDA approved or suitable for medical applications, then it was not designed for a research lab.
- "Low-cost" or "Economical": These are codewords for "disposable."

Sources

British Standard for Autoclaves for sterilization in Laboratories (BS 2646), Laboratory Apparatus Standards Policy Committee, 1990.

Guidelines for the Preparation, Storage and Handling of Microbiological Media, Janet E. L. Corry, C. A. Oscroft, 1991.

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Protein Purification Protocols, Paul Cutler, 2004.

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