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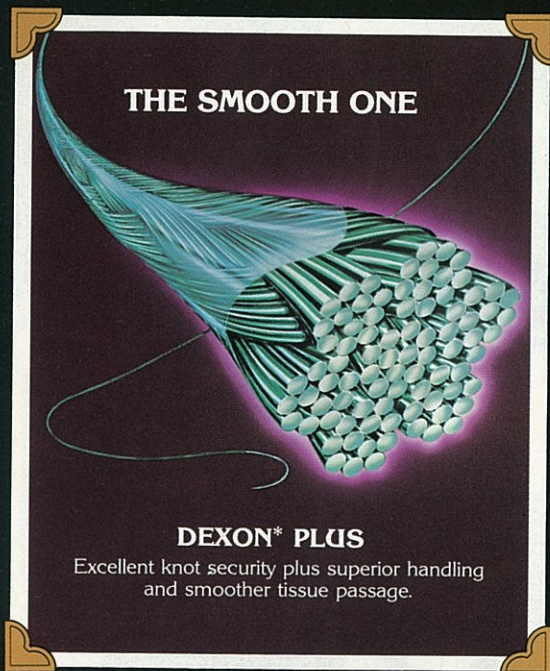


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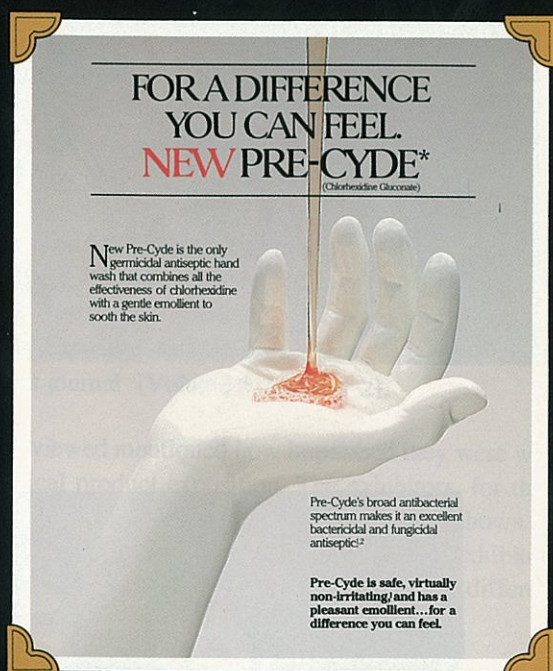
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# Steam sterilization systems

## How they work (Part 1)

By Barbara Bolding, R.N., B.S.N.

When a hospital sterilizer fails to function as it should, the sterility of materials for use at the operative site cannot be ensured. Thus, it is important that operating room nursing staff know as much as possible about the sterilizers they use and how the sterilizing system works. In this submission, the first of two parts, the author reveals that sterilization consists of more than just closing a door on a load and then pressing the operating button.

### Objective of sterilization

When sterilizing, the objective is to kill all microorganisms that may be present on instruments and other devices and materials used during surgery. Heat is used to do this. Heat over time will kill microorganisms, and the greater the heat, the shorter the time required.

Hospital sterilization aims at reducing the time as much as possible. To minimize sterilization time we do two things:

**One,** we add moisture to heat. Moisture in the form of steam improves heat transfer and therefore killing efficiency. Moist heat kills faster than dry heat.

**Two,** we increase the temperature of the moist steam.

Steam normally has a temperature of 212°F (100°C), the boiling point of water. The only way to increase its temperature is to put it under pressure. To achieve a steam temperature of 250°F (121°C), a pressure of 15 pounds per square inch must be applied. 270°F (132°C) requires a pressure

of 27 pounds per square inch. The relationship between temperature and pressure is fixed. If one is known, the other can be predicted.

A hospital steam sterilizer puts all of these requirements together. It provides moist heat (steam) under pressure (which increases temperature) to shorten the time required to kill microorganisms.

### How they work

Hospital sterilizers work in one of two ways:

- gravity displacement, or
- vacuum

These names describe the way in which air is removed from the chamber prior to actual sterilization. Most operating room flash sterilizers operate by the gravity displacement method.

### Gravity displacement sterilization

In using this method during sterilization, steam enters the chamber at the top, back of the sterilizer. Air, which collects in the bottom of the chamber is forced out the drain line as more and more steam is injected. Once all air has been removed from the chamber, the steam trap, which is heat sensitive, closes the drain line. With the door and drain line shut tight, a pressure-tight vessel is created. As steam continues to be injected, pressure, and hence temperature in the chamber, rise. Gravity sterilization usually operates at a temperature of 250°F.

It is important to remember that this air removal is part of the conditioning (preparatory) phase of sterilization. Actual sterilization cannot begin until all air has been removed from the chamber. Air acts

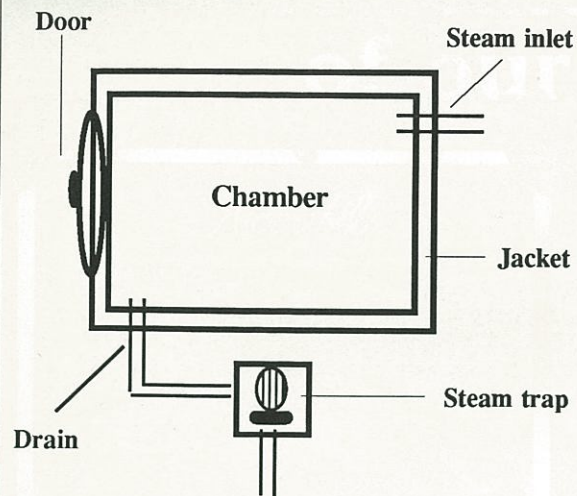


Diagram of sterilizer with gravity displacement

as a barrier to the direct contact of each item by the steam. If air remains trapped in the chamber or within items of the load, sterilization cannot occur.

#### Vacuum assisted

Air removal by the gravity process can be time consuming, especially in sterilizers with large chambers. An improvement on the speed of a gravity cycle is the vacuum assisted method of sterilization. Rather than waiting for air to flow out of the chamber, a vacuum pump sucks it out. With all air gone from the chamber, steam penetration to all parts of the load is almost instantaneous. Total sterilization cycle time is significantly reduced. Vacuum-assisted sterilization usually operates at a temperature of 270°F.

In the 1950s, John Perkins in "Principles and Methods of Sterilization in Health Sciences" defined steam sterilization standards that still apply today. Table 1 summarizes these standard requirements.

Table 1	250° (Gravity)	270°F (Vacuum)
Wrapped hard goods	20 min.	4 min.
Wrapped fabrics	30 min.	4 min.
Liquids	Time varies with volume	Not sterilized by vacuum method

Some examples of wrapped hard goods are instrument trays and basin sets; wrapped fabrics include linen bundles or gown packs.

#### Flash sterilization

Operating room nurses are often required to "flash sterilize" items. The Association for the Advancement of Medical Instrumentation (AAMI) have published a set of recommended practices pertaining to flash sterilization.

What is flash sterilization? Simply put, it is the sterilization of unwrapped items. Flashing allows us to reduce the total cycle time. Sterilization time is reduced because steam can contact items quicker as there is no wrapper to penetrate. Drying time is reduced or eliminated because there is no wrapper to dry.

Flash sterilizers most often operate by the gravity method. However, as chambers are relatively small, air drains out quite quickly. These sterilizers also operate at a higher temperature (270°F) than do standard gravity sterilizers (250°F).

#### Emergency procedure only

The most important thing to remember about the flash method is that it is an emergency procedure. In all instances, wrapped sterilization is preferred because it ensures that sterility can be maintained during delivery to the sterile surgical field.

What is an emergency? An individual surgical item for which there is no sterile replacement, dropped to the floor during a surgical procedure is an emergency. Flash sterilization is required.

Flashing of complete instrument sets is strongly discouraged because there is a reported increased incidence of sterilization failure by this method. If flash sterilization is absolutely necessary, AAMI outlines four criteria which should be met:

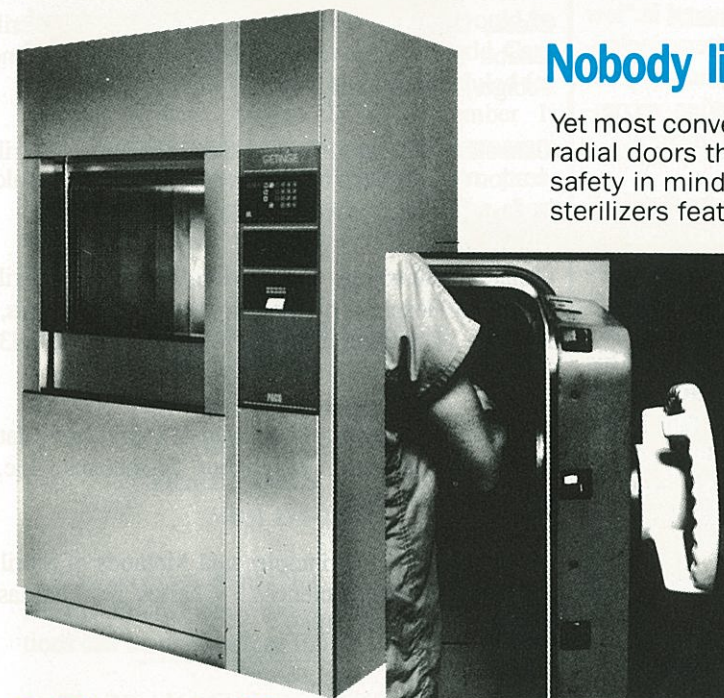
1. There is an urgency for the method to be used.
2. The environment ensures direct delivery of the flashed item to the sterile field.
3. Proper cleaning, inspection and arrangement of instruments into the pan must occur prior to sterilization being initiated.
4. Implants must never be flashed.

#### AAMI recommendations

The standard time and temperature for flash sterilization varies with the sterilizer operating method (gravity or vacuum), and with the item to be sterilized (porous or non-porous). The recommendations on the following page are from the AAMI:

# Staff getting burned up over your sterilizer? Better get a Getinge.

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Table 2	270°F (Gravity)	270°F (Vacuum)
Non-porous	3 Min.	3 Min.
Porous	10 Min.	4 Min.

**Standards recommended by the AAMI for time and temperature variables in flash sterilization**

Examples of porous items are rubbers, plastics, items with lumens such as suction tips, tubings, needles and towels (for padding instrument trays).

Besides flash sterilization, the other variation in sterilization methods sometimes encountered is "low pressure" sterilization. Manufacturers of items including certain dermatomes, power guns, mammary prostheses, and cardiac valve measurers often recommend using the low pressure sterilization method.

**Low pressure sterilization**

Low pressure sterilization is sterilization by the gravity method at a temperature of 250°F. Steam at this temperature has a fixed pressure of 15 psi, which is much lower than the 27 psi of 270°F. This lower temperature could be the difference between an item melting or not. Also, because this is the gravity method, there is no vacuum in the cycle. A vacuum could possibly draw lubricant out of motorized parts, or it could rupture sealed gas or liquid pouches within an item.

Sterilization time by the low pressure method will vary. Device manufacturers should supply this data. Keep in mind though, that without a vacuum, air removal will be slow and air entrapment can easily occur. If air removal is incomplete, sterilization cannot be ensured.

In short, steam sterilization can be accomplished in one of three ways:

1. Standard gravity displacement at a temperature of 250°F.
2. Vacuum assisted at a temperature of 270°F.
3. Flash - which is gravity displacement at 270°F.

**Conclusion**

Sterilization is a complicated, technical process. Effectiveness depends on more than closing the sterilizer door on a load then pressing the button. Knowing how a sterilizer functions is the first step in solving problems when it doesn't function properly.

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**About the author**

Barbara Bolding, R.N., B.S.N., studied nursing and operating room nursing at the British Columbia Institute of Technology in Burnaby, B.C. She received her B.S.N. from the University of British Columbia.

Currently, she is co-ordinator/instructor for the Sterile Supply Processing Training Program at Vancouver Community College, and instructor in the British Columbia Institute of Technology post-basic nursing program.

The content of this article on steam sterilization was taken from a major address the author presented at the 10th National Conference for Operating Room Nurses held recently in Vancouver. The second part of this submission on steam sterilization systems will be presented in the September issue.

**PRESENTATION OF PAPERS  
for**

**VI World Conference  
of Operating Room Nurses  
Vienna, Austria,  
August 28 - September 1, 1989**

**--- Theme ---  
Secure the Future:  
Professional Perioperative Practice**

Operating room nursing personnel in Canada are invited to submit abstracts and/or a brief description of a topic (see below) they would be interested in speaking on at the VI World Conference of Operating Room Nurses scheduled for Vienna, Austria, August 28 to September 1, 1989. Besides a brief description of the program topic you are interested in speaking on, prospective speakers are requested to submit a short biographical note, before July 15, 1988, to the following address:

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The program topics for the VI World O.R. Nurses Conference from which speaking selections can be made are as follow:

1. **The Nursing Shortage:**
  - Recruitment and retention
  - Employer responsibility for the caregiver
  - The new worker status in the world
2. **Reconstructive Surgery:**
  - Digit and limb reconstruction after trauma
  - Facial maxillary reconstruction
  - Reconstruction after burns
3. **Perioperative Nursing Research**
  - Findings of four researchers and how the findings have been implemented in practice
4. **Influencing Practice Through Speaking and Writing in the Workplace.**
  - Influencing through speaking
  - Presenting yourself, framing things

- Influencing through writing: business, communication

**5. New Advances in Surgery: Implications for Nursing Care**

- Second generation lithotriptors: gall bladder/kidney
- Intervention radiography: cardiovascular applications
- Endoscopic laser interventions

**6. Developments in Pain Management**

- Conventional drug therapy/epidural
- Patient controlled analgesics
- Alternative approaches/pain management:
  - Environmental
  - Music
  - Preparation through teaching
  - Relaxation

**7. Professional Accountability in the Team Setting**

- Patient care planning
- Who is accountable for what?
- Documentation

**8. Perioperative Care of the Elderly**

- Special needs
- Major surgery
- Day surgery
- Dealing with the family and family care giver

**9. Infectious Diseases: Universal Care**

- Patient care and the rights of the patient
- Protection of the healthcare worker
  - Mandatory protection steps, economics of protection, different codes for different countries.
  - Include HTVL, all AIDS virus designations, hepatitis B)

**10. Managing for Success**

- Interviewing and selection of staff
- Motivation
- Counselling of staff

**11. Conflict in the Workplace**

Confrontation, Negotiation, Mediation

**Note:** Deadline for submitting brief details on subject interested in speaking on, plus short biographical note to above address is July 15, 1988.