

INFECTION CONTROL hotline

If your system is banging, you'll need to take action. Getting liquid out of the steam is critical.

source notes



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about this column

This column presents answers and practical guidance to some of the most commonly asked questions of suppliers and educators in the infection control and sterile processing communities. To submit a question to the column, e-mail Bob Kehoe, executive editor, at rkehoe@healthforum.com.



How to spot trouble in steam sterilization

Having seasonal problems with wet packs? Finding green or black specks on packs? Unsure how to locate a steam trap? These and other issues continue to perplex many sterile processing departments. Learn more about these issues and how steam quality and the water volume in steam can impact results.

Q: We're experiencing wet packs, and the sterilizer literature talks about required steam quality. What's steam quality?

Here's a simple test. When you start a sterilizer, if you hear banging from behind and above the unit, you have a steam quality problem. Steam quality measures how much liquid water is traveling with the steam vapor. It is expressed as a weight percentage. If 100 pounds flows through the steam line, and five pounds of it is li-

quid water, then 95 pounds is steam vapor. It is 95 percent steam quality (see table at right).

So, here is the tricky part. In the table, the last column shows the steam-to-liquid by volume. The steam vapor occupies about 350 times the volume of the same mass of liquid. Even 50 percent steam quality is 99.9 percent steam by volume. Some sterilizer manufacturers specify 97 percent to 100 percent steam quality. It is normal to have 80 percent to 90 percent steam quality in a typical system.

A system expert can test your system to determine the steam quality. If your system is banging, you'll need to take action. Getting liquid water out of the steam is critical, as the following answers also illustrate.

Q: I've called the boiler room, and they say the steam quality is good. Where else could the water come from?

The boiler can be making perfect steam, but your sterilizer is still receiving poor steam quality. Condensation of hot steam against the cooler pipe wall forms liquid water. Pipe insulation has a big impact on steam quality. An uninsulated steam pipe can flood with liquid water in a matter of hours. It can flood in minutes if the insulation is wet. Insulation may be missing, old or wet from steam leaks. Normal piping design can develop steam speed of 60 to 100 miles per hour. The liquid water does not trickle in the bottom of the pipe at that speed. It moves as a high-velocity spray and even as a high-speed slug.

Slugs can cause banging in the pipe. That's why the steam system must have drain legs (drip legs) to remove the liquid water at various points along the piping. The sterilizer steam filter acts as a drain

Table. Steam quality comparison

Vapor	Liquid	% by weight	% by volume
100	0	100	100.000
97	3	97	99.997
95	5	95	99.995
90	10	90	99.989
80	20	80	99.975
50	50	50	99.901

This table assumes 100 pounds of steam and water flowing at 60 psi system pressure.

The term "steam quality" is shown as the percent by weight column.

Note the volume column. When steam quality is 50 percent, it is still 99.9 percent steam by volume.

leg, too. If your system is old, expanded or even new, the drain legs might be forgotten, missing, clogged, have failed valves or be installed incorrectly. A steam system expert can help you check insulation, the location and function of the drains, all the way back to the steam supply.

Q: What does the literature mean by dynamic steam pressure? I read 60 psi on the gauge, but sometimes it drops, and the gauge needle vibrates.

Dynamic steam pressure is the gauge reading when steam is flowing. Good pipe and valve sizing can make a big difference here. As steam flows, the pressure drops. Think about water leaving a hose; it only flows due to the pressure difference. In the steam system, no flow would happen if there wasn't a pressure drop.

Bigger pipes and valves create lower pressure drops, but are more expensive. By specifying a dynamic pressure, the sterilizer manufacturer is telling the system designer to size the piping carefully. Dynamic steam pressure is very dependent on steam quality. Liquid water can choke the flow of steam through valves and piping. When you turn on a garden hose, air and water mix and choke the flow through the nozzle. The gauge reading will bounce around when slugs or choked flow occur. A properly sized and piped system will have dynamic pressure problems when the steam quality is poor. The gauge will vibrate when slugs of water choke the valves.

Q: We get wet packs in the winter and summer, but not spring and fall. Why is that?

The steam boilers keep up with higher loads in winter and summer. As the boilers make more steam, they "throw" more liquid water out with the steam vapor.

Think about boiling water on a stove. Making more steam on really high heat creates "messy" boiling. The same thing

happens in the boiler on a larger scale. The steam load increases in the winter to heat the facility. It can also increase in the summer to power the chilled water plant. (Yes, steam can make things cool.) A hot, humid day can create a huge steam load, resulting in poor steam quality.

Most hospitals experience a sudden surge in steam load throughout the day. At 7 a.m., the doors are opening, the kitchen is cooking, showers start, the laundry starts ... and the sterilizers start. It's not unusual to see steam quality change hourly. If your facility has a loop system, the steam may flow in different directions

Fig. 1. Pipe droplets forming a slug

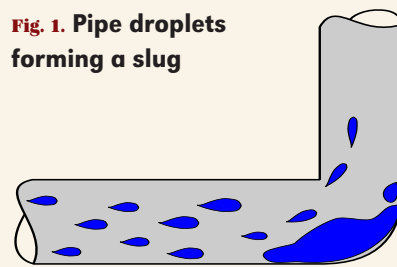
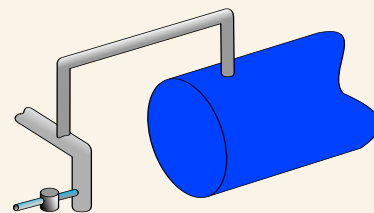


Fig. 2. Boiler piping is designed to catch water



as the load changes. Depending on the take-off location for the sterilization steam, steam quality can change based on direction of the loop flow.

Q: I'm getting green specks on packs, and the filters were just changed. What could be causing this?

Think about the Statue of Liberty, or copper gutters. They turn green when they oxidize. Green specks most often come from copper or bronze piping. Sometimes it's piping downstream of the filter. Poor steam quality can cause specks (in addi-

tion to wet packs). Specks of any kind are a sign that liquid water is flowing to the sterilizer.

High-velocity water scrubs the copper oxidation off the pipe wall, and then green specks occur. Black specks come from steel or iron piping. Proper system drainage helps prevent specks.

Q: We failed a Bowie-Dick test, and we're supposed to change a steam trap. What is a steam trap?

A steam trap is an automatic valve. It drains liquid water and vents air, but keeps (traps) steam in the system. It opens its inner valve, and steam pressure pushes the undesired fluid out. There are several different kinds of steam traps. The ones most commonly found on sterilizers are

thermostatic bellows types (see Fig. 3). The bellows open and close the valve. The bellows has a fluid inside that responds to the temperature outside the bellows. Like a musical accordion, the bellows compresses or expands, which opens and closes the valve. The bellows is made from metal and typically breaks every few years.

NOTE: Bowie-Dick test packs are designed as a simple check of vacuum pump performance, but also can show steam trap failure on the jacket. Some facilities also use them to check for gravity displacement unit performance issues, even though this is not

the original purpose of the test. The test checks that air is being vented from the sterilizer chamber on startup. If the steam

trap valve fails in the closed position, the Bowie-Dick test can fail, since air can't push through a closed valve. The sterilizer jacket and chamber will not reach steam temperature if they are full of air instead of steam.

Steam traps are located at system drain legs and on steam filters. Traps are tested with a special ultrasonic stethoscope and temperature

sensor to ensure they are working correctly. Because traps fail every few years, an expert can test them while checking the piping. **MMHC**

Fig. 3. Thermostatic bellows steam trap

