

August 2020

The self-study lesson on this central service topic was developed by 3M Health Care. The lessons are administered by Endeavor Healthcare Media.

Earn CEUs

After careful study of the lesson, complete the examination at the end of this section. Mail the completed test and scoring fee to *Healthcare Purchasing News* for grading. We will notify you if you have a passing score of 70 percent or higher, and you will receive a certificate of completion within 30 days. Previous lessons are available at www.hpnonline.com.

Certification

The CBSPD (Certification Board for Sterile Processing and Distribution) has pre-approved this in-service for one (1) contact hour for a period of five (5) years from the date of original publication. Successful completion of the lesson and post-test must be documented by facility management and those records maintained by the individual until recertification is required. DO NOT SEND LESSON OR TEST TO CBSPD. For additional information regarding certification, contact CBSPD - 148 Main Street, Suite C-1, Lebanon, NJ 08833 • www.sterileprocessing.org.

IAHCSMM (International Association of Healthcare Central Service Materiel Management) has pre-approved this in-service for 1.0 Continuing Education Credits for a period of three years, until July 7, 2023. The approval number for this lesson is **3M-HPN 200707**.

For more information, direct any questions to *Healthcare Purchasing News* (941) 927-9345, ext. 202.

LEARNING OBJECTIVES

1. Describe the steam quality attributes necessary for effective steam sterilization.
2. Define “noncondensable gases” and understand how they may impact sterilization.
3. Discuss the importance of a proactive communication strategy between SPD and boiler plant personnel.

Sponsored by:

3M Health Care

SELF-STUDY SERIES

Steam requirements for sterile processing

An overview of revisions to the ANSI/AAMI ST79 Standard

by Walt Deacon

Sterile Processing is often regarded as the “front line” for fighting infections. Following proper protocols and standards is critical if we are to win that fight. This article will discuss recommendations in ANSI/AAMI ST79:2017 *Comprehensive guide to steam sterilization and sterility assurance in healthcare facilities*, while highlighting information important for Facilities and Design engineers to be aware of if they are to successfully support the Sterile Processing Department (SPD). Content for this article has been derived from multiple sources, including the Association for the Advancement of Medical Instrumentation (AAMI).

The ANSI/AAMI ST79 Standard is an all-encompassing standard, covering everything from steam conditions, airflow, temperatures, and water quality through the SPD. It offers guidelines and recommendations that “should” be followed. “Should” indicates the most suitable option among several possibilities. It may also suggest that a certain course of action is preferred but not necessarily required. Additionally, it may highlight when a certain possibility or course of action should be avoided, but is not prohibited.

What makes steam used for sterilization so special?

It is important to remember that the last thing to touch an instrument or textile before it’s used on a patient is steam. The Standard says there are two common sources for steam used in sterile processing: hospital steam boiler systems and self-contained electric boilers. In both cases, a treated water supply is necessary to remove total dissolved solids

(TDS). Each system should be designed, monitored, and maintained to ensure that the quality, quantity, and purity of the steam provided are appropriate for effective sterile processing. With that standard in mind, you should reach out to your engineering staff and ask for a walkthrough of the boiler room, making sure they show you the solids measurement and controls.

What are the parameters of steam quality?

The Standard describes steam quality as having three parameters: dryness, non-condensable ratio, and superheat. It offers acceptable levels for those three parameters and stresses the importance of assessment and documentation upon installation or relocation of the sterilizer, as well as after any change to the steam distribution lines or boiler supply water.

What is dryness?

Steam dryness is a measure of how much liquid water is present in the flowing steam. It is expressed as a “dryness fraction,” which is a percentage by weight. The Standard says steam dryness should be between 97% and 100%. This dryness fraction is measured at the inlet to the sterilizer. Most boiler plants do sampling of the steam near the boiler header to

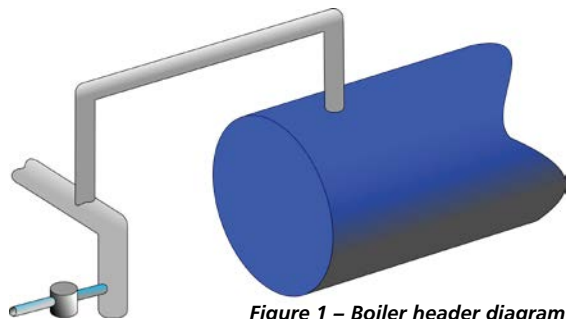


Figure 1 – Boiler header diagram



Figure 2 – Boiler header in a healthcare facility



Figure 4 Deaerator (DA) tank in boiler room

detect any boiler carryover. You may want to request that engineering take samples from behind the sterilizers.

A sample cooler in the boiler plant typically condenses some steam from the header or main boiler to measure solids and pH levels. If liquid is being discharged (carry-over) by the boiler, it shows up as a high solids concentration. The same measurement can also be used at the sterilizer. Liquid water at the sterilizer might be boiler carry-over but can also be condensate. Condensate is the equivalent of distilled water and will not have a high solids concentration.

What if dryness is too low?

If too much liquid water flows into the sterilizer chamber, a ‘wet load’ may result. Any liquid water present on or in the sterilized container can breed bacteria, becoming a threat to patient safety. If that happens, it must be reprocessed - an expensive and potentially hours-long procedure. Unfortunately, the problem is sometimes not discovered until containers are opened in the surgical suite. If that happens, reprocessing becomes an emergency and all other items processed with the wet load are recalled.

Unlike most other hospital processes (except humidification) the steam is injected directly into the sterilizer. This makes SPD one of the first departments to know if there is a steam system issue.

The sterilizer is designed to deal with soaking wet instruments. The steam is intended to condense on the instruments, creating the ‘time and temperature’ required to achieve sterilization. The drying cycle is programmed to pull a vacuum, causing the condensation to return to

steam. When there is too much ‘extra liquid’ carried with the steam, the dry cycle can’t handle it and a wet load would be the result.

What are Non-Condensable Gases (NCGs)?

NCGs are defined as gases that cannot be liquefied by compression under the conditions of temperature and pressure used during the sterilization process. These gases are more commonly known as air, CO₂, and O₂.

‘Air’ refers to the atmospheric air that is introduced into the sterilizer chamber when the door is opened, or into the steam piping when the system is opened for maintenance. The steam system normally loses water over time due to leaks, humidification, and boiler blowdown (flushing the boiler). The system needs some fresh water to make up for these losses. Air is introduced into the system with this fresh water, as well as carbonates. Carbonates

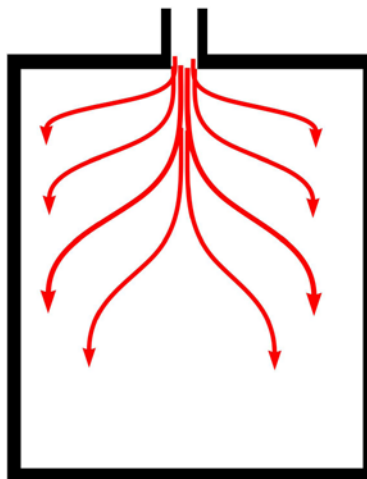


Figure 3 Steam Flow in the sterilizer

are the primary source of NCGs. When heated in the boiler, the carbonates (CO₃) break down, producing oxygen (O₂) and carbon dioxide (CO₂). These two gases can cause problems with corrosion. Boiler treatment adds chemicals to the system to head off the negative corrosive impacts of CO₂ and O₂. The boiler water pre-heater or Deaerator (DA) Tank are designed to remove dissolved air and NCGs from the boiler feedwater.

It is crucial to note the importance of daily testing

to determine if there are problems with the DA tank. The Bowie-Dick test, which measures air removal, combined with the routine use of biological indicators (BIs) to confirm cycle lethality, will help identify failure in the steam system or the presence of NCGs. As a result of this continuous testing, SPD is one of the first areas to be aware of a steam system upset.

According to the Standard, the level of NCGs should be at a level (less than 3.5% v/v condensate) that will not impair steam penetration into sterilization loads.

What if the NCG level is too high?

Air and NCGs can cause problems with the sterilization process in two ways; first, they lower steam temperature and second, they occupy space - insulating the instruments we are trying to heat and sterilize. The more air that is present, the harder it becomes to reach the 270°F temperature required by the sterilization cycle. During a sterilization cycle, steam flows towards the instruments, collapsing and condensing as it transfers heat to the instrument. The steam flow also pushes air and NCGs towards the instruments - much like wind pushing balloons towards the surface of the instrument. Since they don’t condense, they can collect at the instrument surface, creating a heat transfer barrier.

What is Superheat?

Superheat is steam that is hotter than saturation conditions, which prevents condensation. Superheat can be found in large campus systems or district (city) steam-by-design. It can also be the result of a large reduction in pressure through a pressure-reducing station. It is unlikely

Key
 ● Condensate
 ● Steam
 ● Air and Non-condensable Gases

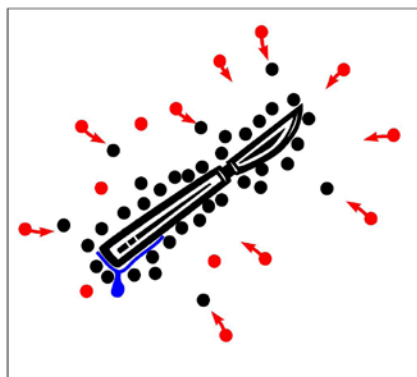
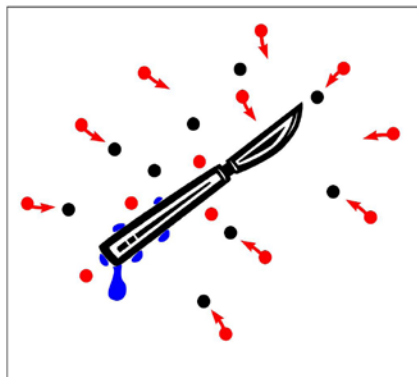
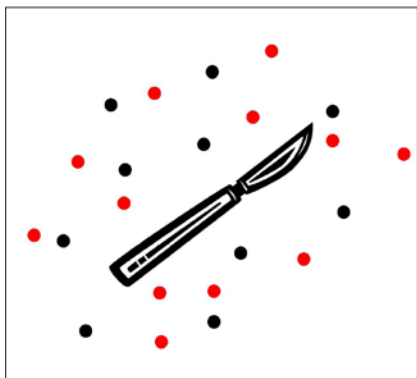


Figure 5 – Steam pushes NCGs toward the instrument surface

to be of significance under normal circumstances that you encounter in hospital steam distribution systems, but superheating might occur if the main steam supply pressure is unusually high (usually 250 psig or above). Superheated steam is an unsuitable medium for steam sterilization. The Standard calls for measurement of superheat of steam expressed as a temperature in degrees above saturation point. This value should be less than 25°C (77°F).

What if superheat is too high?

Superheated steam can cause sterilization failure, scorching of textiles and paper, and

rapid deterioration of rubber. Once again, the sterilization cycle creates wetness and superheat prevents wetness. The sterilizer chamber is usually jacketed with 30 psi steam, so having dry steam in the chamber is more like cooking pizza in an oven, as opposed to the desirable, wet conditions needed to prevent sterilization failure.

What is dynamic pressure?

Sterilizer manufacturers specify a minimum pressure needed to operate and sterilize effectively. This is measured as steam pressure during peak steam flow. Total steam demand, and the corresponding capacity necessary to support that, should be determined so that the steam supply system can be designed and built to meet peak demands of the facility. You must be able to ensure that constant steam pressure is available at all times and under all conditions of steam demand to properly operate sterilizers.

What if dynamic pressure is too low?

In our experience, there are two symptoms of low steam quantity. First, the sterilizer will sound alarms, especially door seal alarms found on newer sterilizers. Secondly, wet steam issues can happen sporadically, without rhyme or reason. High pressure drops are proportional to high velocity, causing condensate to flow past trap stations. Sudden pressure drops can impact trap performance and responsiveness. Consider asking that high quality gages be installed on the sterilizer steam supply, as well as a transducer, to constantly monitor steam pressure.

What about treatment chemicals, especially amines?

Caution is advised when using amines for conditioning steam lines as the injection of amines directly into the sterile steam supply can create a staining issue, as well as high pH if the pump were to overdose the line. To avoid this, ask to see the amine injection point and request it not be directly in the SPD steam supply.

Monitoring and alarms

Procedures should be in place for the preventive maintenance, repair, and monitoring of boilers and steam distribution lines that provide steam for sterile processing and for the documentation of corrective actions. This means that a pressure monitor is a good idea, and that traps and insulation on the sterile steam supply should

be “hyper-managed.” Most facilities check traps to find the energy loss created by leaking valves. For this reason, temperature monitoring of traps on the sterile steam supply is a good idea. A best practice is to ask that preventive maintenance be done monthly on the traps between the boilers and SPD. This maintenance can be as simple as regular surveying with an infrared thermometer gun.

In addition to testing the boiler water conductivity or total dissolved solids (TDS), the monitoring and testing program for boilers should generally include determination of:

- Incoming water hardness, pH, iron content, and alkalinity;
- Boiler water alkalinity and pH; and
- Condensate return alkalinity, conductivity, sulfites, and pH.

In the battle against infections, the SPD can arm itself with ANSI/AAMI ST79:2017, which suggests ways to ensure that the quality, quantity, and purity of the steam provided are appropriate for effective sterile processing. Key take-aways include:

1. Conduct a steam quality validation whenever a sterilizer is relocated, steam piping changes are made to the sterile steam supply, or boiler water supply systems change. Values to be tested are dryness fraction, NCG level, and superheat.
2. Monitor steam pressures, trap operation on the sterile steam lines, and water chemistry (incoming, boiler, and condensate return) on a continuous basis.
3. Consider implementing a proactive communication strategy, so that it's the boiler plant calling SPD to notify them of a steam system upset, rather than the other way around. **HPN**

For reference:

Association for the Advancement of Medical Instrumentation. Comprehensive guide to steam sterilization and sterility assurance in health care facilities. ANSI/AAMI ST79:2017. Arlington, VA. 2017

For recommendation:

Facilities and Design Engineers should review Section 3, Annex L (Steam quality) and Annex O (Moisture assessment)



Walt Deacon is currently Vice President at ThermoDiagnostics and holds an MBA from Western Michigan University and a bachelor's degree in mechanical engineering from Purdue University. He is a voting member in multiple working groups at AAMI and a well-known speaker in topics related to steam sterilization systems.

CONTINUING EDUCATION TEST • AUGUST 2020

Steam requirements for sterile processing

Circle the one correct answer:

1. Superheated steam can be found in sterilizers with steam supply higher than 250 PSI.
 - A. True
 - B. False
2. One possible cause of stained packs can be attributed to the use of amines.
 - A. True
 - B. False
3. Steam sterilization inactivates microorganisms through condensation.
 - A. True
 - B. False
4. Adequate steam quality must have an almost perfect balance of the following elements: dryness, non-condensable ratio and superheat.
 - A. True
 - B. False
5. Steam parameters should be checked once a month.
 - A. True
 - B. False
6. Dryness can be defined as how much air can be found within the steam supply.
 - A. True
 - B. False
7. A consequence of low steam dryness can be the presence of wet loads.
 - A. True
 - B. False
8. Time and temperature during steam sterilization is created by 'soaking the instruments' with condensed steam.
 - A. True
 - B. False
9. Air is a good example of non-condensable gases.
 - A. True
 - B. False
10. The maximum percent of non-condensable gases in a load is 10%.
 - A. True
 - B. False

CONTINUING EDUCATION TEST SCORING



The approval number for this lesson is **3M-HPN 200707**.

HPN is thrilled to now offer all CEU quizzes online by scanning the QR code on the right or visiting: <https://educationhub.hpnonline.com>. **The cost to take the quiz online remains at \$10.**

Due to rising costs if you would like to mail in your completed quiz using the method below the price is now \$50 for each test taken.

Request for Scoring

I have enclosed the scoring fee of **\$50 for EACH test taken** – payable to **Endeavor Business Media**. We regret that no refunds can be given. (It is not necessary to submit multiple tests separately.)

Detach exam and return to:

Continuing Education Division
Healthcare Purchasing News
2477 Stickney Point Road, Suite 221B
Sarasota, FL 34231

