I have a sterilizer that is not passing the Bowie-Dick tests. What could cause this problem?

A Bowie-Dick test is used in prevacuum type steam sterilizers (also called dynamic-air-removal sterilizers), not gravity-displacement sterilizers. The purpose of this test is to ensure all air is removed from the sterilizer and that there are no air leaks in the system. Steam must make contact with all surfaces in order for the item to be considered sterile. The test kit itself is composed of clean preconditioned cotton surgical towels and a Bowie-Dick test sheet (Class 2 chemical indicator). The test pack should be placed in the front bottom portion of the sterilizer over the drain line. The pack should be placed horizontally on the rack.

The air that is not removed from the sterilizer chamber will prevent steam from making contact with a surface. Trapped air inside the test pack will cause the indicator to change color, which is indicative of steam being unable to reach the chemical indicator positioned deep in the pack. Should a sterilizer fail the Bowie-Dick test, the sterilizer should be immediately removed from service and service personnel should evaluate the unit.

So now that we know air is not being removed from the sterilizer, we need to understand the piping of a sterilizer and then see what valves close and open when. A prevacuum sterilizer uses a pressure pulse and a vacuum pulse to remove air from the sterilizer. Some companies and brands use several pulses. Rapid removal of air from the chamber and the load results in shorter cycle time, increasing productivity. There are three phases in all steam sterilization cycles. The first phase is a conditioning phase in which air is removed and steam is introduced into the chamber. In the case of prevacuum sterilizers, this is accomplished by those pressure and vacuum pulses mentioned earlier. The second phase is the sterilization phase. In this phase, the preset temperature is maintained for a preset amount of time. An example would be 270°F for four minutes. The next phase is the exhaust phase, during which steam is exhausted from the chamber and the cycle is completed. It is now easy to see that if the Bowie-Dick is failing, it is a result of lack of air removal in the first phase of the sterilization process.

Now I will discuss what items in the plumbing of that sterilizer could cause this problem. You should be mainly concerned with the conditioning phase because this when the air is removed. The sterilizer must first be purged. The valve allowing steam to enter the chamber must open, and the fast-exhaust valve must open to allow all the air to flow out. The cooling water valve, the vacuum valve, and the steam-to-jacket valve must intermittently open and close, allowing steam to make contact with all surfaces in order for the item to be considered sterile. The vacuum to jacket valve must intermittently open and close, allowing the sterilizer to maintain overall temperature and jacket temperature. Next, a vacuum will be introduced to suck air out of the load and the chamber. This is accomplished by closing the steam-to-chamber valve and opening the cooling vacuum water valve and the cooling water valve; the steam to jacket valve will pulse intermittently to maintain jacket temperature. This vacuum is usually pulled for a minute or two. Then, a pressure pulse will be initiated. After the second vacuum and pressure pulse (could be less or more depending on the manufacturer and model), a charge pulse will be initiated by means of closing the fast-exhaust valve, opening the steam-to-jacket valve, and opening the steam-to-chamber valve; the vacuum cooling water valve works intermittently. Once the pressure reaches a preset value, the sterilization phase will be initiated. After the second vacuum and pressure pulse (could be less or more depending on the manufacturer and model), a charge pulse will be initiated by means of closing the fast-exhaust valve and opening the steam-to-chamber valve; the steam-to-jacket valve will operate intermittently for a portion of the cycle. Once the pressure reaches 32 psi or 270°F (or whatever the preset is), the sterilization phase will be initiated. It can be seen that the valves to investigate in the case of a Bowie-Dick test failure are the exhaust valve, the steam-to-chamber valve, the cooling water valve, the vacuum cooling water valve, and the steam-to-jacket valve. The one I would start with is the cooling water and vacuum valve.
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