



Vapors on Vapor

This issue of Vapors will discuss the function of vaporizers and their output. This discussion will begin with a fictional scenario. Gabby, a healthy 40 lb. female border collie, was anesthetized to remove a lump from her leg. There was a crisis during the anesthetic procedure that resulted in post anesthesia complications and required intensive care for 48 hours. As a result, the owners did not want to pay the ICU expenses and started pursuing the issue. The client asked to see the patient record and any service records for the anesthetic machine. The anesthetic record did not reveal anything that would explain the crisis. However, upon examination of the service record for the machine and vaporizer, it was noted that at 3% the vaporizer was reading 3.4%. It was observed from the anesthetic record that Gabby was anesthetized at 3% for a short time at the beginning of surgery.

The owners claim that because the vaporizer is not functioning properly, it was the cause of the crisis. Is this a legitimate claim? It is not. Many people think if a vaporizer is set on 2%, that the output is exactly 2%. This is not correct. Vaporizers operate within a certain tolerance. Most manufacturers have a $\pm 10\%$ tolerance on new vaporizers. Some have a tolerance of $\pm 15\%$. Anesthesia service companies may have a $\pm 20\%$ tolerance. Dorsch and Dorsch states "the average delivered concentration from the vaporizer shall not deviate from the set value by more than $\pm 20\%$ or $\pm 5\%$ of the maximum setting, whichever is greater, without back pressure".¹ They are quoting from the ASTM anesthesia workstation standard. It is almost impossible to have vaporizers read exactly what is on the dial due to the way they function. The vaporizer consists of 1) a sump for holding liquid agent, 2) a wick that is partially submerged in the liquid, 3) a rotary valve (see figure 1) with appropriate marks to indicate the concentration, and 4) a thermostatic device that changes with temperature. If the vaporizer is off, all of the oxygen flow bypasses the sump (see figure 2).



Figure 1

When the vaporizer is turned on, a small part of the flow is diverted into the sump to carry some of the vapor from the sump to be mixed with the remainder of the flow. If the oxygen flow is 1 liter/minute and the vaporizer is set on 1%, approximately 30cc of the flow is diverted into the sump, through the wick and then mixed back into the main flow (see figure 2). As the setting on the dial is increased, more of the flow is diverted through the sump to carry more of the vapor from the sump (see figure 1). The oxygen is diverted into the sump by a resistance to flow created by the thermostat. It is not hard to understand that observing an accurate reading would be very difficult; however, getting precise readings should be expected. This means that if a vaporizer is checked and is reading +12%, that is what the vaporizer should read in subsequent years. A change from that indicates there may be a problem. Vetamac's VICTOR database allows the service technician to

look at the previous readings and make decisions about the function of a vaporizer.

The anesthetic vaporizer is the heart and soul of the anesthetic machine and with proper attention will provide many years of service. **However, let's remember that the depth of anesthesia and condition of the patient is not determined by observing the setting on the vaporizer but by observing the patient.**

¹Reference Book: Dorsch and Dorsch: Understanding Anesthesia Equipment; 5th Edition; page 128.

Figure 1: A rotary valve from a Tec 3 style vaporizer. This is the rotary valve that the dial turns as the setting is changed. Note that starting at the top and going counter clockwise around the outside of the valve, the groove becomes deeper allowing more oxygen to flow through the sump thereby increasing the concentration.

Figure 2: The view on the left shows the vaporizer off with all the oxygen bypassing the vapor chamber through thermostat C and rotary valve passage A to rotary valve outlet B. The view on the right shows the vaporizer on with some of the oxygen bypassing through thermostat C and some passing through passage D (B is closed) into the vapor chamber. It passes through calibrated channel E into vaporizer outlet F where it is mixed with bypassed oxygen from C.

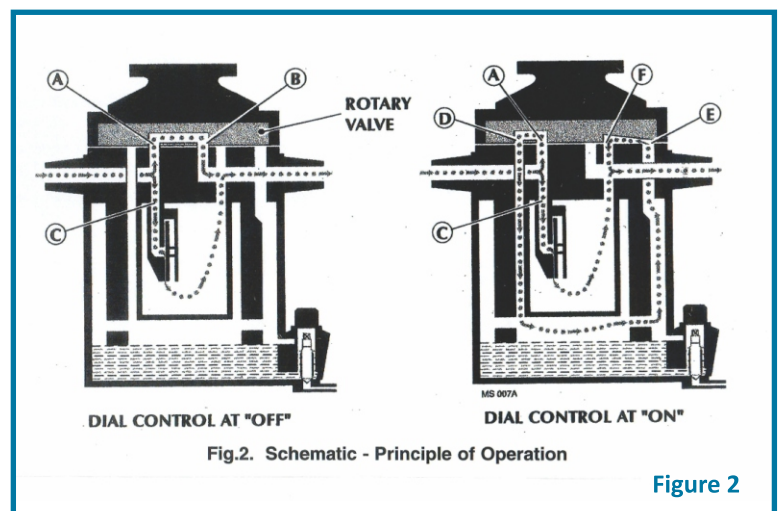


Fig.2. Schematic - Principle of Operation

Figure 2

By Harry Latshaw MS, RVT, VTS (Anesthesia)

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We regret to inform you that **Stefanie Skiles** is no longer employed by Vetamac. Stefanie and her husband have decided to relocate. She began her employment with Vetamac in March 2006 and has served as a vaporizer lab technician and a field service technician in Indiana.

She will be missed and we wish her well in her future endeavors!