



Laboratory CO-Oximetry and the Value of the Radiometer OSM3

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Invasive laboratory CO-oximetry testing provides clinicians with crucial diagnostic information about hemodynamic and respiratory status. For many scientists, a CO-oximeter is a vital tool for obtaining accurate reference measurements of the four primary species of hemoglobin and of the concentration of total hemoglobin in human blood samples or from any one of a number of research animal species. For device manufacturers, a CO-oximeter often provides the gold standard values used in agreement studies to establish the accuracy and precision of a number of noninvasive monitors including, most notably, pulse oximeters¹ and more recently noninvasive devices capable of measuring the dysfunctional hemoglobins, carboxyhemoglobin and methemoglobin, or the concentration of total hemoglobin^{2,3}.

While there are many laboratory CO-oximeter manufacturers, and many of them make more than one model of CO-oximeter, one workhorse has been in use since at least the early 1980s: the Radiometer OSM3 CO-oximeter. This particular CO-oximeter provides several advantages for the end user that appear to be unavailable from any other commercially-available device, even after more than 30 years of continued development in the field of CO-oximetry.

The advantages of the OSM3 include:

- 1) ***Small Sample Volumes:*** Readings can be made on sample volumes as low as 35uL;
- 2) ***Completely Stand-Alone:*** It is a completely standalone CO-oximeter. It is not built and sold in combination with blood gas analysis, electrolyte measurements, or any other additional *in-vitro* diagnostic tests that add cost, complexity, and/or measurement time;
- 3) ***Fast Measurement Times:*** Typical sample insertion-to-measurement display times is under 20 seconds. The unit displays the measured analyte levels before washing out the internal tubing thus providing the end user with analyte readings on samples as early as possible in the measurement cycle;
- 4) ***Accurate Species-Specific Measurements:*** It makes accurate measurements of the four primary species of hemoglobin (oxyhemoglobin, carboxyhemoglobin, methemoglobin, and reduced hemoglobin) as well as total hemoglobin on humans and 10 select animal species via the inclusion of user selectable “animal matrices,”
- 5) ***Simple Text Output of Results:*** It provides a simple ASCII-based serial output of the measurement results.
- 6) ***Sample Injection:*** It allows larger than required sample volumes to be injected by syringe, which may improve measurement accuracy in cases of low oxygen saturation samples; and
- 7) ***Low Operating Costs:*** It can be operated at very low cost because it does not require expensive replacement sensor cartridges or rinse solution packs with severely limited lifetimes.

Kestrel Labs is a research facility involved in the development and testing of noninvasive medical monitoring technologies and has been using laboratory CO-oximeters constantly over

the past 11 years. To date, Kestrel Labs has found no other commercially-available CO-oximeter with this combination of features and advantages, regardless of the initial price of the instrument.

It is also interesting to note that the measurement precision of CO-oximetry appears to have improved only slightly over the past 30 years, despite the fact that the OSM3 CO-oximeter uses only 6 wavelengths to make its measurements, whereas many of the newer instruments use in excess of 100 wavelengths⁴.

It is likely that the primary advantage of the vast increase in the number of wavelengths used is a reduction in the sensitivity of newer instrumentation to various interfering substances.^{5,6} The small number of wavelengths used by the OSM3 may make it more vulnerable to measurement errors in the presence of certain interfering substances such as unknown quantities of fetal hemoglobin, sulphemoglobin, and serum bilirubin and certain diagnostic and therapeutic dyes.

The greatest disadvantage of the OSM3, however, is that it is no longer manufactured, sold, serviced, or supported by Radiometer. Fortunately, a small group of individuals and companies are still providing solutions and service for this instrument for those researchers who still find the OSM3 too valuable to part with. *See additional information about OSM3 service on the “Services” link on the www.KestrelLabs.com web site.*

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3. Macknet MR, Allard M, Applegate RL, 2nd, Rook J. The accuracy of noninvasive and continuous total hemoglobin measurement by pulse CO-Oximetry in human subjects undergoing hemodilution. *Anesth Analg*; **111**(6):1424-6.
4. Pearson S BW, Halloran SP, Thomas A, and Vandyken S. Survey of fourteen blood gas analysers (sic). NHS Centre for Evidence-Based Purchasing Report #05091. *London* Jan 2006.
5. Pamidi PV, DeAbreu M, Kim D, Mansouri S. Hydroxocobalamin and cyanocobalamin interference on co-oximetry based hemoglobin measurements. *Clin Chim Acta* 2009; **401**(1-2):63-7.
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