



**Smiths Medical PM, Inc.
Patient Monitoring and Ventilation**

WHY PULSE OXIMETERS DON'T NEED CALIBRATION

Most monitors used in hospitals today require the user to perform a calibration to a known standard before reliable clinical results are possible. Generally, this involves a “zero calibration” and a “gain calibration”. Pulse oximeters do not require a zero calibration because the design incorporates continuous automatic zero calibration. Gain calibration is not required because the measurement technique does not require gain accuracy. A brief review of pulse oximetry theory shows why this is possible.

Laboratory co-oximeters determine the %HbO₂ (%SaO₂) by measuring the amount a specific frequency of light is absorbed as it passes through a known volume of blood. In contrast, pulse oximetry (SpO₂) measures the change in light absorbed at systole and diastole. This allows the pulse oximeter to distinguish between the constant amount of light absorbed by the tissue, bone, venous blood, etc. from the arterial blood (the blood in the volume change due to the pulse). The absorbance of this volume of the arterial blood is calculated from the ratio of light measured at systole to that measured at diastole. Since the same gain is used for both light measurements, the amount of gain is mathematically canceled by taking the ratio. This means that gain accuracy is not required to compute the absorbance of the arterial blood pulse, so that gain calibration is not required.

The pulse oximeter completes the measurement of SpO₂ by using the absorbance to two light frequencies (red and IR) to automatically correct for the unknown volume of blood for each pulse. It is the ratio of the two absorbencies that indicates the %SpO₂. Because this is not a linear relationship, the absorbance ratios are used to select the specific SpO₂ from the monitor’s “look up table”. The “look up table” is essentially a built-in standardization curve that was developed empirically by simultaneous measurement of %HbO₂ and the light absorbencies.

The usual reason for calibrating an instrument is to correct for changes in the sensor, electronic circuitry or the patient. Since the pulse oximeter eliminates zero calibration electronically and ignores gain variations mathematically, no calibration, beyond the manufacturer’s “calibration” of the look up table is required.

