Establishing the Transmission Wavelength of Light Sources in Pulse Oximetry Probes.

The light intensity produced by a forward biased light emitting diode (LED) is dependent on the amount of current it is allowed to conduct. The amount of current it accepts is proportional to the voltage placed across it, by Ohm's Law.

However, the wavelength of the produced light is dependent on the material from which the LED is constructed. LED's are now available, having very narrow tolerances with respect to transmission wavelengths but nevertheless, no two diodes are absolutely identical.

Current oximeters compensate for diverse patient characteristics, such as change in finger diameter and skin pigmentation, by altering the intensity of the light sources. A typical voltage placed across the red or infrared LED in use, is 1.8V. The actual range of voltages that the oximeter is capable of operating at, could be as low as 1.4V and up to 2.0V. It has been found that the change in terminal voltage placed across the LED not only changes the intensity at which it lights, but also the spread of wavelengths transmitted. Therefore, all LED's are tested at their respective 'switch on' voltage, being approximately 1.5V for red and 1.2V for infrared. At these lower voltages, the initial transmission wavelength is very precise and is shown by a very peaked display on the spectrometer. Figure 1a shows a narrow band of wavelengths of a red LED, resulting from a terminal voltage of 1.45V.

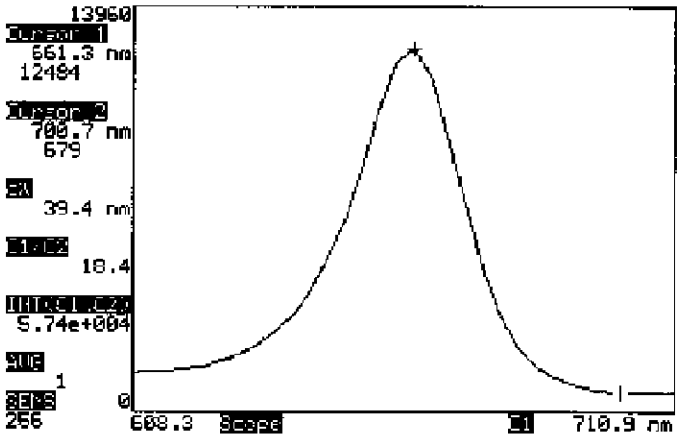

Figure 1.

There are several factors which affect the appearance of the trace shown on the spectrometer display. The light to be tested is 'collected' via a optical fibre. The orientation and distance of the 'open' end of the fibre from the light source makes a marked difference to the spectrometer display, particularly the intensity reading. Changes in the orientation of the spectrometer probe do not effect the wavelength of the sampled light.

In all spectrometer tests carried out on the light sources in the following oximeter probes, every effort was made to sample the light emitted under consistent conditions, particularly the presentation of the spectrometer probe to the light source. Each LED within the package was illuminated individually, using a measured 1.8V across it's terminals. However, if this voltage

level was inconclusive to the primary transmission frequency , the terminal voltage was reduced to a level where a positive peak could be seen.