



Considerations for Measurements By Laser Doppler Flowmetry

In preparing to use a BLF laser-Doppler flowmeter, several factors must be considered. Among these are: motion of the probe head, tissue or fiber optic cable; pressure on the tissue; temperature of the air or tissue; sterilization of the probe; method of recording results and time constant switch setting.

Motion: In order to quantify the flow of blood, care must be taken to eliminate other sources of motion. Doppler devices measure relative motion. A laser Doppler flowmeter measures the shift in frequency between the light it emits and that which it receives. This shift is imparted when the light strikes an object which is moving, relative to the probe head. The shift is described by the Doppler effect. Ideally, wavelength shifts are imparted only by moving blood cells, However, motion between the tissue and probe head, within the tissue under the probe head; or bending motion of the probe's fiber optic cable can also produce a signal (frequency shift). This is artifact rather than blood flow. Of these motion artifacts, by far the most important is probe-to-tissue motion. Avoid this type of motion through careful selection of a probe holder (see Technical Note #106). If the tissue to be studied has moving filaments crossing the path of the laser light, a significant artifact signal can result. Experiments must be performed to determine if the meter's signal is meaningful in cases where tissue motion is significant. Finally, while earlier instrument's probe designs allowed for large fiber bending motion artifacts, this is not the case with BLF laser Doppler probes. However small, this artifact signal is worth eliminating, so fixing the probe cable in several points is appropriate.

Application Pressure: Since the laser Doppler is measuring a relatively shallow portion of tissue (about 1 mm deep), a very light application must be used so as not to occlude the small underlying vessels. In order to determine the correct pressure of application, it is best to apply the probe and take a reading. Then move the probe back from the tissue slightly and take a second reading after 15 seconds. If the second reading is higher, the first application was likely done with too much pressure. Additionally, it is best to use a chart recorder or computer interface to display the waveform. This very readily shows the difference between tissue occluded by pressure and non-occluded tissue. One final note, pressure applied to tissue proximal or distal from the probe can influence the perfusion and, therefore, the instrument readings.

Ambient Temperature: Room temperature has a significant effect on peripheral blood flow. In some studies, the maximal flow in tissue is important (this may be measured by warming the tissue to 42° C). In other studies, the blood flow at room temperature may be most important, but careful control of the temperature is essential. Also important is time to allow subjects coming in from other temperature levels to acclimate.

To Sterilize: Prior to using the laser Doppler probes intraoperatively, they must be sterilized using cold gas (ethylene oxide at 65°C) or STERRAD. DO NOT AUTOCLAVE laser Doppler probes. Following use, any blood or tissue adhering to the probe may be removed in a hydrogen peroxide bath (do not dip the connectors).

To Not to Sterilize: When using the probe for cutaneous measurements, an alcohol wipe may be sufficient between subjects. When making readings on multiple subjects, a disposable clear plastic probe covering is recommended. For pencil or needle type probes, use an oral thermometer sheath; for larger probes other types of plastic sleeves will be useful.

Recording Considerations: You should decide if you will use hand recording of the data from the digital display, an analog recorder or a computer connected to either the analog output on the back panel or the optional RS-232 output (see Technical Note LTN-103). The Time Constant Switch (T/C) on the rear panel controls the filter for data going to any external recorder (see Technical Note LTN-105).

