

## Testing Cassette Pumps at High Flow Rates

When testing pumps at rates over 400 ml/hr, the Infutest 2000 should display flow measurements on the LCD every **10 seconds** or less. However, when testing certain **cassette pumps** at these high rates, Infutest may not produce any measurements at all! One such pump is the **IMED 960** operating at rates over 700 ml/hr.

As you may know, cassette pumps work by alternately filling up a cassette with fluid and then discharging the fluid from the cassette at a predetermined rate. During the fill cycle, the pump produces no flow. To make up for this "dead time", the pump must at some point discharge the cassette *faster* so the *average rate* approaches the rate you set the pump to.

Depending on the flow rate and the volume of the cassette, the pump may require nearly as long to fill the cassette as to empty it. At high flow rates, a cassette pump may therefore produce short bursts of flow *greater than twice* the rate you selected in order to compensate for the zero-flow filling time.

Measurements displayed on the Infutest's LCD are based on the time it takes the injected bubble to move through the glass tube as determined by optical sensors along the tube.

This system is designed to accurately measure flow up to **1000 ml/hr**. Between 1000 and **1700 ml/hr**, the Infutest will measure the flow but with reduced accuracy. At flow rates above 1700 ml/hr, the injected bubble zips through the glass tube in less than 2.5 seconds !!! Because the bubble moves so fast, Infutest *rejects* the bubble as a spurious "artifact". Up to the operational limit of 1700 ml/hr, Infutest *uses* this ability to reject little air bubbles in the test fluid which would otherwise cause measurement errors.

However, some cassette pumps can produce short flow bursts when set to high rates. If such a flow burst delivers more than 1 ml of fluid at an average rate exceeding 1700 ml/hr, Infutest will reject its own bubble as a spurious "artifact" and no measurements will be displayed on the LCD.

So when testing *cassette pumps* at higher rates, remember that for a short period of time the pump could produce a flow too high for Infutest to measure. This is probably what is happening if Infutest appears

to takes much longer than 10 seconds to measure above 400 ml/hr. Reduce the flow rate setting on the pump until you find the maximum rate at which you can use the Infutest.

For example, when the **IMED model 960** cassette pump is set to 800 ml/hr, it initially starts pumping at just over 800 ml/hr. Then, when the syringe in the cassette is emptied, the pump refills the syringe. This takes about 5 seconds. To make up for the 5 seconds of zero flow, the pump starts off the next cycle by delivering about 2 ml of fluid at over **1800 ml/hr**. Infutest is not able to measure a rate as high as that, and so simply "stops measuring".

Because of this behaviour, the maximum rate at which an **IMED 960** pump can be tested is just below 700 ml/hr. If the IMED 960 is set between 800 and 999 ml/hr, Infutest will begin to measure the flow and then stop when the instantaneous rate exceeds 1700 ml/hr.

The above comments do not apply to the newer IMED Gemini pumps, which are based on a **linear peristaltic** mechanism. The Application Note, *UNDERSTANDING YOUR RESULTS*, provides more information on the different types of pumping mechanisms, and how these differences relate to results you may obtain from Infutest when testing them.