

### Inflow

This test has many names including Forearm Bloodflow, Venous Occlusion Plethysmography, and Arterial Inflow. The instruments used for this test include the EC6, EC5R, and TL400 Strain Gauge Plethysmograph, in conjunction with the E20 Rapid Cuff Inflator.

The NIVP3 software will support two protocols. The protocol to perform a single channel test (one arm or one leg at a time) is as follows:

1. Balance (zero) the plethysmograph
2. Inflate the venous occlusion cuff
3. Collect the waveform from the strain gauge
4. Deflate the venous occlusion cuff
5. Wait the specified amount of time to repeat the above 4 steps

To measure two limbs at the same time, additional instrumentation is required. Two plethysmographs must be used, and one or two E20 Rapid Cuff Inflators. The protocol for a two channel test (two arms or two legs at the same time) is as follows:

1. Inflate the wrist or ankle occlusion cuffs with the first E20 (if only one E20 is being used, this step is skipped)
2. Balance (zero) the plethysmographs
3. Inflate the venous occlusion cuffs
4. Collect the waveforms from both strain gauges
5. Deflate all venous and arterial occlusion cuffs
6. Wait the specified amount of time to repeat the above 5 steps

For either protocol, the NIVP3 software will automatically balance the strain gauge plethysmograph and control the E20 Rapid Cuff Inflator(s).

The first step is to set the **Reading Interval** and **Inflow Time** in the software. The **Reading Interval** is the time from the beginning of one measurement to the beginning of the next measurement. The default is 15 seconds. The **Inflow Time** is the length of time for which the inflow measurement is recorded. The minimum **Inflow Time** is 4 seconds (measurement time should include at least 2 to 3 heart beats) and the maximum is 7 seconds.

Set the plethysmograph range(s) on the front of the instrument, then click the radio button on the screen corresponding to the range. If you are using only one plethysmograph, the range column labeled **#1** applies to the plethysmograph. If two plethysmographs are used, **#1** applies to the plethysmograph plugged into the **Pleth 1** serial port on the IB4 Interface Box. The ranges in column **#2** apply to the plethysmograph plugged into the **Pleth 2** serial port.

Next, click the **Inst. Check** button to make sure waveforms are being collected properly. Either one or two lines (depending on the number of plethysmographs being used) should move horizontally from left to right across the screen. The red line represents **Pleth 1**, and the green represents **Pleth 2**. If the lines do not appear, check all cable connections and **Com port settings**. Adjust the waveform

towards the lower quarter of the waveform box using the position control on the front of the plethysmograph(s). If two plethysmographs are being used, adjust the positions so that one waveform is slightly offset from the other. Press the [Spacebar](#) to exit the Instrument Check screen.

Make sure the E20(s) is in Preset mode, and the correct pressures are set on each one (approximately 50 mmHg for venous occlusion cuffs, and between 150 and 250 mmHg for arterial occlusion cuffs).

To begin taking measurements, click the [Start Readings](#) button. This will commence the first measurement. When the instruments have all been set up correctly, the following steps occur

1. The arterial occlusion cuffs inflate (if tests are being performed with two E20 Rapid Cuff Inflators),
2. The plethysmograph will balance (the waveform will momentarily jump up then back down towards the bottom of the waveform box).
3. The venous occlusion cuff(s) will inflate.
4. The waveform on the screen will rise as the arteries in the limb fill and the limb volume increases.
5. All cuffs will deflate and a timer appears on the screen, showing the remaining time until the next measurement.
6. The above steps repeat until the signal is given to stop.

To pause readings, click the [Cancel](#) button in the message box that appears between readings, or press the [Esc](#) key. When the measurement is paused, a new window appears with four options and two timers.

If a test has been performed on the patient in between readings or stages, i.e. reactive hyperemia or drug injection, which may increase the inflow rate, the instrument and software ranges may be changed so that the inflow waveform does not go off scale. Change the range on the front panel of the plethysmograph, then click the radio button for the new range setting.

Comments can be added to individual inflow readings while the measurement is paused. Click the [Edit Inflow Readings](#) button, which returns you to the [Inflow](#) window. Type comments in the right-hand column in the space associated with the selected reading. Click [Return to Pause](#) (in the lower left corner) when you want to continue taking readings, or end the test.

*Note: All Inflow readings should be edited. The user must tell the NIVP3 software where to start and stop the slope measurement.*

Inflow readings can be edited at any time after the measurements have been completed. To edit readings, return to the window called [Inflow](#). The column labeled [Status](#) will show whether the reading is [Not Edited](#), [Edited](#) or [Re-edited](#). In the column labeled [Reading](#) select the first reading to be edited. Click the [Edit](#) button.

In the screen that appears, one or two inflow waveforms are ready to be edited. Two vertical cursors are also present. The inflow measurement is calculated from

the line tangent to the waveform between the two cursors. To move the first cursor, click on it with the mouse and drag it to the left or right. Very small steps can be made using the left and right arrow keys. Then click on the second cursor and drag the mouse to the left or right.

A red arrow at the bottom of the waveform indicates when the venous occlusion cuff was inflated. Move the left cursor to the first systolic peak after cuff inflation. Move the right cursor to the second or third peak. As each cursor is moved, the inflow rate updates indicating the inflow rate based on the current cursor positions.

*Note: If a step exists in the waveform near the cuff inflation point, this represents cuff artifact, which is not true inflow. Measure from the first peak (heartbeat) following any cuff artifact.*

*If two waveforms are collected, the Channel 2 cursors track Channel 1. If there are reasons to edit the two waveforms separately, Channel 2 can be edited by itself after Channel 1 is set.*

The NIVP3 software will automatically move the cursors to the closest associated peaks when the **F2** key is pressed.

After all inflow readings have been edited, the **Graph** button will display an inflow reading vs. time graph. A complete **report** can be printed from the **Report** menu in the **Patient Demographics** window (close the Inflow window to return to Patient Demographics).