## Application Note 158:   ON-LINE ANALYSIS OF INSPIRED AND EXPIRED VOLUME

This application note describes how to automatically determine inspired and expired lung volume on a breath-by-breath basis using Acq*Knowledge*® or BSL *PRO* software and BIOPAC TSD107B, TSD117A, TSD117A-MRI, SS11LA/LB, or equivalent pneumotach airflow transducers. The following procedure can be used to analyze human or animal data.

1. Calibrate the flow transducer (see Transducer Application Note 114, 114b or 135 for BIOPAC transducers).

2. To measure the inspired volume on a breath-by-breath basis, isolate the inspired portion of the flow signal.

    - This can be achieved using the Acq*Knowledge* or BSL *PRO* online calculation channels.

    - The same can also be achieved using the off-line analysis functions found within the Transform menu.

3. To isolate the inspired signal, use the **Limit** function.

    - The Limit function allows you to set two thresholds, one upper and one lower. Only data that falls within the two thresholds is used. In the case of inspired volume, use 0 liters/sec as the lower threshold and 6 liters/sec as the upper threshold. The lower threshold will cut off everything below 0 liters/sec and the upper threshold will cut off everything above 6 liters/sec.

    a.) From the MP menu, select Set Up Data Acquisition > Channels and select Channel A1 (check Acquire, Plot, and Value).

    b.) Name this channel "Airflow" in the Label field.

    c.) Click Setup and in the Scaling dialog, change the units to Liters and click OK.

    d.) Click the Calculation channel tab.

    e.) Using the pull-down Preset menu, select Function and click Setup.

    f.) Select Analog Channel A1 as the Source for the calculation.

    g.) Select the Limit calculation from the pull down Function menu. Enter 0 for the Lower threshold and 6 for the Upper threshold.

    h.) Click OK as required to close all dialogs and exit setup.
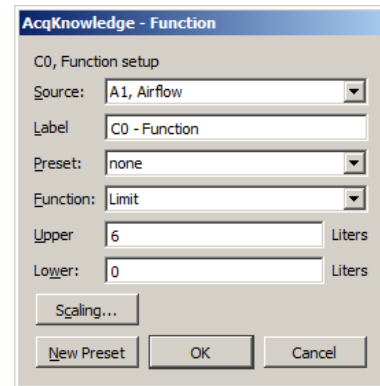
    The software will automatically isolate each inspired cycle.

4. To automatically determine the volume of each cycle, use the Area function from the **Rate** calculation.

    - This will provide a breath-by breath reading of the inspired volume.

    a.) Select another Calculation channel from MP menu > Set Up Data Acquisition > Channels.

    b.) Select **Rate** as the calculation.

    c.) From the Rate setup dialog box, turn the Source channel to the calculation channel with the result of the Limit function).

   d.) From the Output tab, select **Area** from the Function menu.
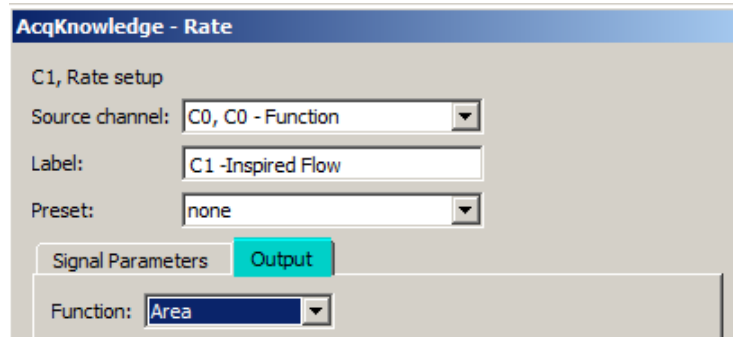
    e.) Click the Signal Parameters tab and choose the following settings:

    - Peak Detect = Negative to allow the algorithm to calculate the area under the curve of the inspired flow signal.

    - Uncheck "Remove baseline."

    - Check "Auto threshold detect."

    - Noise rejection = 5.0% of peak.

    f.) Windowing Units = BPM. Adjust the Peak Interval Window to suit the subject's respiration rate (human at rest: 5 and 25). As necessary, adjust the Peak Interval Window to allow the rate algorithm to track the signal better.
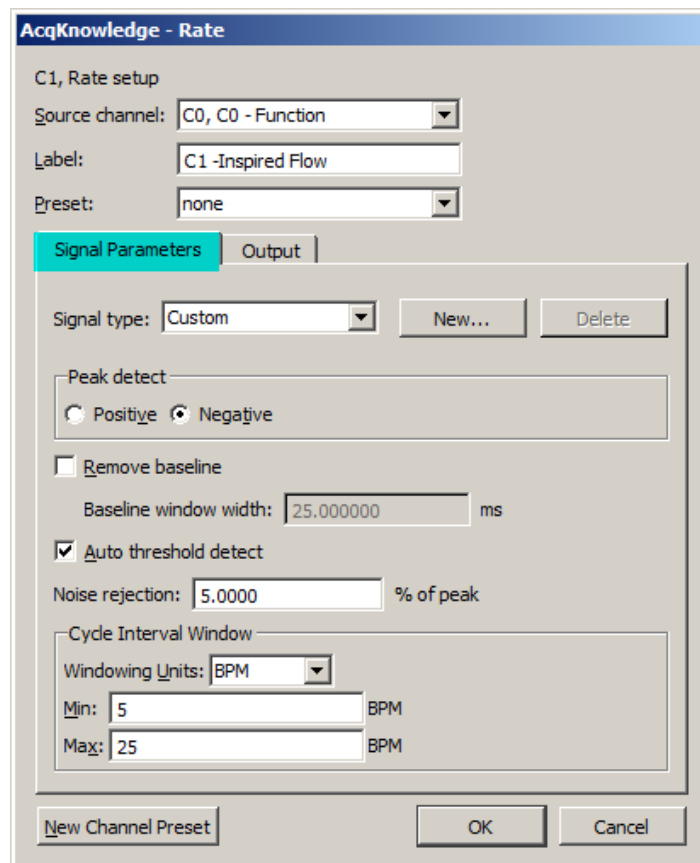
You are now ready to start recording.

The Area function will take a few respiration cycles before it starts to track, but will kick in and provide you with a display similar to the data screen below, with the air flow signal and two calculations, inspired flow and inspired volume.
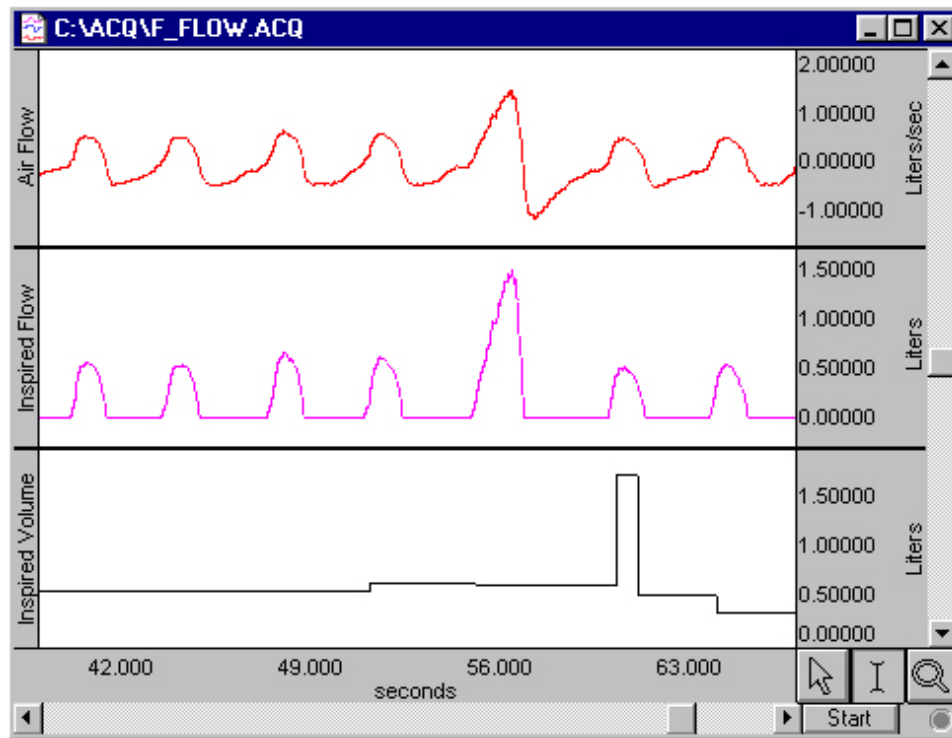
Expired volume can also be determined by adjusting the Limit settings. Set the Lower limit threshold to 0 liters/sec and the Upper limit threshold to -2.0 liters/sec. The upper limit must be set to a number greater than the most negative deflection of the signal (peak expired flow). Adjusting the Limit threshold cuts off the positive portion of the signal and leaves the negative part.
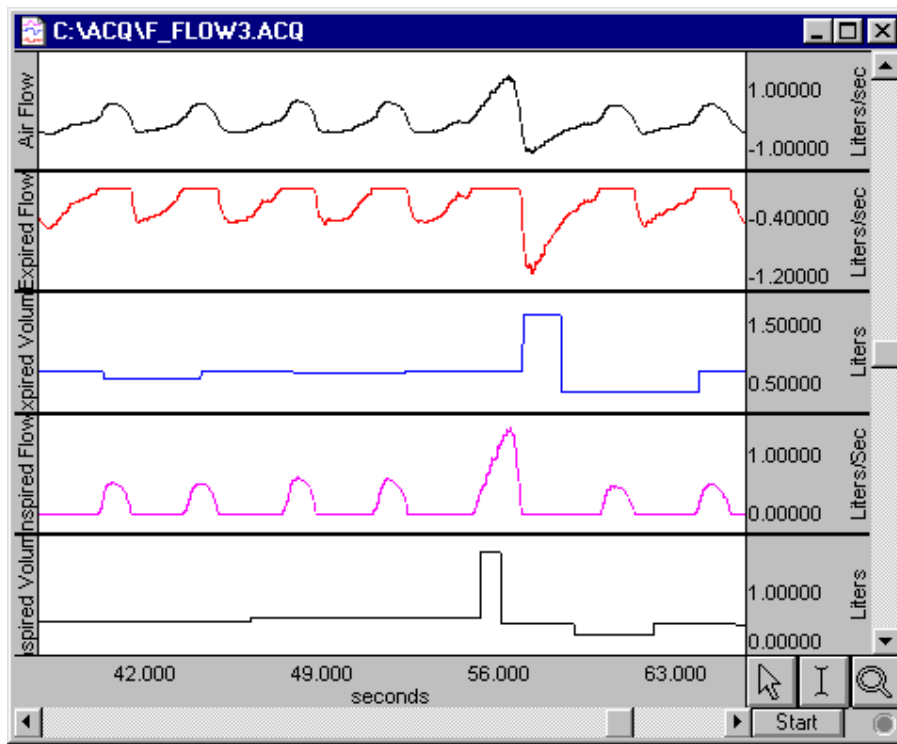
Expired lung volume can be recorded with some adjustments to the Rate calculation. From the Rate setup menu, select the appropriate calculation channel as the source and select Area from the Function menu. To calculate the area of the negative going waveform, use a Positive Polarity. Set the Peak Interval Window to suit the subject's respiration rate (human at rest: 5 and 25).