

Breath by Breath Analysis & Chamber Sampling

Breath by Breath Sampling

The American Thoracic Society (ATS) recommends on-line or off-line measurement of exhaled nitric oxide (NO). However, in some situations, the subjects will not be able to perform this maneuver (ventilated subjects, small children, and animals). In these cases the breath by breath technique can be used.

For ventilated subjects, the Sievers* Nitric Oxide Analyzer (NOA) sample inlet tubing and tubing from an auxiliary pressure transducer are connected, via a tee, to the ventilator circuit at the Y-piece adapter to the ET tube. Gas is continuously withdrawn from the circuit by the NOA and the flow rate can be selected using different flow restrictors ranging from 10-200 mL/min to match the minute ventilation and tidal volumes.

For non-ventilated subjects, a non-rebreathing valve is used and the NO sampling and pressure transducer lines are connected to the valve.

The auxiliary pressure transducer is used to determine the beginning and end of each exhalation. The Sievers NOAnalysis software permits calibration of the offset between the pressure and NO signals. The Breath Program is used to determine the minimum, maximum, and plateau or end-tidal NO concentrations for each breath. The program permits processing of a selected portion of the data files and differentiates between ventilated and spontaneously breathing measurements.

Breath by Breath Accessories

- Gas Sampling Line
- NO/Pressure Offset Calibration Kit
- NOA Calibration Kit
- Flow restrictors (for measurements at flow rates < 200 mL/min)

Chamber Sampling

The chamber sampling technique is a simple and rapid method for measuring exhaled NO from small animals

(e.g., rats and mice) using a head-out, double chamber plethysmograph. The head chamber is flushed with NO-free air, then sealed for a few seconds to allow exhaled breath to accumulate. Contents of the chamber are then flushed into the NOA for measurement.

The head-out, double chamber plethysmograph is preferred to a single chamber system as the head-out configuration helps to minimize NO from urine and feces. The measurement consists of four steps:

1. The animal is placed in the chamber.
2. The stopcocks are positioned to flush the head-out chamber with low NO air.
3. The stopcocks are positioned to seal the chamber for short period of time (typically 5-15 seconds depending on the size of the head-out chamber). During this time, zero air flows directly to the NOA.
4. The stopcocks are repositioned to flush the accumulated NO to the NOA.

Replicate measurements can be performed by repeating these steps while the animal is in the chamber.

The duration of the collection period will depend on the size of the chamber, the size of the animal, and the tidal volume/respiratory rate of the animal. Since the chamber is sealed, the animal can become hypoxic if the collection period is too long. The best procedure is to start with a short collection period to see if enough NO accumulates to give a significant increase above the background NO. Increase the period if amount of accumulated NO is not enough.

NOAnalysis Software-Breath Program

Sievers NOAnalysis Software includes four custom programs with data collection for liquid sampling, restricted exhaled breath, breath by breath and bag sampling. The Breath Program is used for the breath by breath technique.

Features

- Flexible technique: measurement of ventilated and spontaneously breathing subjects
- Real time display of NO and exhaled breath pressure
- Adjustable graphical view: zooming, panning, and auto-scaling
- User adjustable breath detection based on pressure or NO
- Automatic calculation of results
- Digital data capture and storage in tab-delimited text files enabling direct import to spreadsheet or statistical programs

