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Water & Process Technologies
Analytical Instruments

Application Note

Restricted Exhaled Breath Analysis (On-Line)

The restricted exhaled breath technique is the preferred method for measuring the concentration of nitric oxide (NO) in exhaled breath. The maneuver requires biofeedback from the subjects, and is thus limited to spontaneously breathing adults and children over age six. The measurement of the concentration of NO in exhaled breath is complicated by two factors: contamination by nasal NO and variable expiratory flow rates. The nasal cavity and paranasal sinuses can contain up to a thousand times higher concentration of NO than found in the lower airway air.

During exhalation, turbulent mixing results in NO contamination of exhaled breath from nasal origins. The concentration of NO in exhaled breath is also highly flow dependent. As air passes up the airway, it picks up NO from cells lining the bronchus. If the air passes rapidly up the airway, a lower concentration of NO will be measured in the exhaled air compared to air passing slowly up the airway.

The restricted exhaled breath technique is the method recommended by the American Thoracic Society (ATS). The technique uses expiratory resistance to elevate mouth pressure and close the vellum to eliminate nasal contamination. In addition, by monitoring and displaying the mouth pressure, the subject can maintain a constant pressure and achieve a constant expiratory flow rate. The concentration of expired NO measured using this technique is extremely reproducible.

Sievers On-Line NO Breath Kit

The Sievers* On-Line NO Breath Kit is designed to meet ATS guidelines for the on-line collection of exhaled NO samples at a flow rate of 50 mL/sec.

The apparatus for measuring exhaled NO using this technique consists of:

- Tee-shaped two-way non-rebreathing valve
- Mouth port tube with luer fittings for connection of the sample and pressure lines
- Exhalation port tube with luer adapter
- Four single subject bacterial/viral filters
- Set of six calibrated flow restrictors ranging in flow rates from 30 mL/sec – 250 mL/sec

The breath kit can be utilized with all age groups by using different size, interchangeable mouthpieces. The [NO] in inspired air can affect exhaled NO levels. The ATS recommends that the [NO] in inspired air be <5 ppb for children over 12 years old and for adults. The inspiratory filter is available for use with the On-Line NO Breath Kit to achieve these low inspiratory [NO] levels.

Sievers Flow Meter Kit

The Sievers Flow Meter Kit is designed to provide direct measurement of expired breath flow rates during on-line analysis. It fits the On-Line Breath Kit and interfaces with the Sievers Nitric Oxide Analyzer (NOA).

In early techniques the exhaled breath flow rate was monitored indirectly, by first measuring the mouth pressure, then using a flow/pressure curve included with the NOAnalysis Software to calculate the flow rate. Using the Flow Meter Kit with the On-Line Breath Kit, the expired flow rate is now measured directly. This kit includes a TSI thermal mass flow meter, cable to interface with the analyzer, and a clip for convenient attachment to the NOA.

Restricted Exhaled Breath Accessories

On-Line NO Breath Kit	CRBK 01400
Flow Meter Kit	CACC 01420
Gas Sampling Package	CASM 03300
NOA Calibration Kit	CNCK 01400
Bacterial Filters (cs. of 50)	CAFL 01420
Inspiratory Filter	CAFL 01410

NOAnalysis Software – Restricted Exhaled Breath

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

Features

- User definable breath pressure and flow rate
- Real-time graphical display of nitric oxide and exhaled breath pressure/flow rate
- Adjustable graphical view: zooming, panning, and auto-scaling
- Up to 10 plateaus per subject
- Computer calculated or user adjustable setting of NO plateau
- Automatic calculation of mean, standard deviation, and %RSD for each subject
- Data storage in tab-delimited text files enabling direct import to spreadsheet or statistic programs

References

1. *American Journal of Respiratory Critical Care Medicine;* Vol. 160: pp 2104-2117; 1999.

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USA
GE Analytical Instruments
6060 Spine Road
Boulder, CO 80301 USA
T +1 800 255 6964
T +1 303 444 2009
F +1 303 444 9543
www.geinstruments.com

Europe
Unit 3 Mercury Way
Mercury Park Estate
Trafford Park
Manchester, UK M41 7LY
T +44 (0) 161 866 9337
F +44 (0) 161 866 9630

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