NOxBOX® Range
Nitric Oxide Monitors and Delivery Systems

www.noxbox.co.uk
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Nitric Oxide (NO) is a recognised and selective pulmonary vasodilator in adults and neonates, and used in the treatment of pulmonary hypertension. NO is added to ventilator circuits in the treatment of patients with severe breathing difficulties. It is used to improve gas exchange and reduce pulmonary arterial pressure in neonate, paediatric and adult intensive care units.

**NO delivery and monitoring**

The use of NO demands precise monitoring and management to avoid causing unnecessary pain and suffering to the patient, this can occur in the following cases:

- NO has a very short duration of action and on its sudden withdrawal, for example the cylinder runs out, there can be rapid pulmonary vasoconstriction and hypoxaemia \(^2\) (rebound).
- Inhalation circuits to deliver NO must ensure the accurate continuous delivery of NO while minimizing levels of NO\(_2\) \(^3\).
- Mechanical or human error may produce inadvertently low or high NO concentrations. Therefore it is essential to monitor NO and O\(_2\) concentrations \(^3\).
- Both NO and NO\(_2\) have the potential for toxicity in clinical use \(^3\). Nitrogen dioxide (NO\(_2\)) is formed rapidly from combining oxygen and NO, the rate depends on the concentration of oxygen and square of NO concentration \(^4\). Approximately 50% of inhaled NO\(_2\) is retained within the lung and once absorbed it remains there for prolonged periods, reacting with water to form nitric and nitrous acids which are responsible for the pulmonary toxicity of NO\(_2\) \(^5\).

In summary the use of accurate, real-time NO and NO\(_2\) monitors is essential in order to ensure the correct dosage, reduce side effects of INO therapy and ultimately improve the patients’ quality of life.

**Sources**

5. Greenough A. Nitric Oxide – clinical aspects. Care of the Critically Ill, July/August 1995; Vol 11 No 4 pp. 143-46
NOxBOX®

Intelligent INO delivery and monitoring system

Portable head unit for restricted space or transfer of patients.

Custom trolley for 2 NO cylinders and 1 O₂ cylinder.

Manual bagging unit ability to provide blend of O₂ and NO.

Colour touch screen making it easy to use and fully interactive.

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Applications

- Persistent pulmonary hypertension in newborn babies
- Acute post operative cardiac patients
- Acute respiratory distress syndrome (ARDS)

The NOxBOX delivers and monitors Nitric Oxide (NO) for use in Inhaled Nitric Oxide (INO) Therapy. Encompassing both continuous and synchronous NO delivery modes for use with adult, paediatric and neonatal patients. The NOxBOX is the ideal product for all your INO needs. The system has a step by step, guided interface to enable ease of use. The NOxBOX is designed primarily for use in hospitals with a portable, detachable head unit to provide continuous treatment for transit and transfer conditions.

The NOxMixer is intended to deliver a continuous flow of Nitric Oxide (NO) from the NOxBOX, mixed in line with oxygen (O₂) for use in Inhaled Nitric Oxide (INO) Therapy. The NOxMixer will be used in conjunction with

Note: Specification details may still be subject to some changes. Overall operation character should be similar to above, but design is not fixed and final. Please refer to device technical guide for most up to date specifications.
### Technical Specification for NOxBOX

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Measuring range:</strong></td>
<td>NO: 0-99.9 ppm, NO₂: 19.9 ppm, O₂: 0-99.9%</td>
</tr>
<tr>
<td><strong>NO delivery range:</strong></td>
<td>0.6 - 80 ppm synchronous mode (Note the system allows setting at &lt;= 0.5 ppm, accuracy figures below are for &gt;= 0.6 ppm, use of a lower setting is at customer responsibility)</td>
</tr>
<tr>
<td><strong>Standby Mode:</strong></td>
<td>Set 0 ppm</td>
</tr>
<tr>
<td><strong>Vent flow range:</strong></td>
<td>0.5 - 50 L/min</td>
</tr>
<tr>
<td><strong>Sample line flow rate:</strong></td>
<td>Approx. 225 ml/min</td>
</tr>
<tr>
<td><strong>Detection principle:</strong></td>
<td>Sealed electrochemical sensor</td>
</tr>
<tr>
<td><strong>Accuracy:</strong></td>
<td>NO &amp; NO₂: +/- 3% or 0.3 ppm whichever is greater plus the accuracy of the calibration gas, O₂: +/- 3.5%</td>
</tr>
<tr>
<td><strong>Resolution:</strong></td>
<td>NO &amp; NO₂: 0.1 ppm, O₂: +/- 3.5%</td>
</tr>
<tr>
<td><strong>Display:</strong></td>
<td>7” Full colour touch screen LCD</td>
</tr>
<tr>
<td><strong>Alarms:</strong></td>
<td>Audible and visible</td>
</tr>
<tr>
<td><strong>Set-up time:</strong></td>
<td>&lt;10 minutes</td>
</tr>
<tr>
<td><strong>Response time:</strong></td>
<td>&lt;10 seconds to 90% FSD NO, &lt;40 seconds to 90% FSD NO₂, &lt;15 seconds to 90% FSD O₂</td>
</tr>
<tr>
<td><strong>Operating temperature:</strong></td>
<td>10 - 35°C</td>
</tr>
<tr>
<td><strong>Storage temperature:</strong></td>
<td>0 - 40°C</td>
</tr>
<tr>
<td><strong>Operating Humidity:</strong></td>
<td>15 - 85% RH non-condensing</td>
</tr>
<tr>
<td><strong>Sensor operating life:</strong></td>
<td>2 years</td>
</tr>
<tr>
<td><strong>Battery life (approx.):</strong></td>
<td>min. 4 hours (operational, excluding alarms)</td>
</tr>
<tr>
<td><strong>Power input:</strong></td>
<td>100 - 240VAC, 50/60Hz, 1.3-0.6 A</td>
</tr>
<tr>
<td><strong>Head unit dimensions:</strong></td>
<td>108 (D) x 330 (W) x 250 (H) mm</td>
</tr>
<tr>
<td><strong>Head unit weight:</strong></td>
<td>Approx. 6kg</td>
</tr>
<tr>
<td><strong>Construction:</strong></td>
<td>Rigid polyurethane (PU)</td>
</tr>
</tbody>
</table>
## Technical Specification for NOxMixer

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO Dose Delivery Range(^1)</td>
<td>0-231ppm</td>
</tr>
<tr>
<td>NO Dose Delivery accuracy(^2)</td>
<td>± 30% or 3 ppm, whichever is the greater.</td>
</tr>
<tr>
<td>NO Dose Delivery response time(^3)</td>
<td>Target &lt; 2 minutes</td>
</tr>
<tr>
<td>NO Dose Delivery Over/Undershoot Transient on dose set point change.</td>
<td>± 25% or 2.5 ppm, whichever is the greater.</td>
</tr>
<tr>
<td>Input NO Flow Range</td>
<td>50 - 600 ml/min @ 1.65bar (23.9psi)</td>
</tr>
<tr>
<td>Continuous Supply</td>
<td>Supply of 1.65bar from manual control valve (23.9psi)</td>
</tr>
<tr>
<td>(\text{O}_2) Flow Range</td>
<td>2 - 25 l/min @ 4 - 7bar (58.0 - 101.5psi)</td>
</tr>
<tr>
<td>Safety notice: NO drug in N2 balance is supplied as a dry gas and is non-oxygenated. It is important to ensure that the volume of this dry gas introduced into the ventilator lines is limited to prevent reducing oxygen supply to the patient or reduction in humidity conditions of ventilated supply.</td>
<td></td>
</tr>
<tr>
<td>Dimensions:</td>
<td>H185 X W65 X D60.8mm</td>
</tr>
<tr>
<td>Weight:</td>
<td>~0.3kg</td>
</tr>
<tr>
<td>Construction:</td>
<td>Rigid polyurethane (PU)</td>
</tr>
</tbody>
</table>

\(^1\) 231ppm achieved by using 1000ppm cylinders, range lowered to 23ppm if used with 100ppm cylinders.

\(^2\) The overall delivery range and accuracy is subject to the constraints of the NOxBOX! Needle valve, ventilator and circuits setup.

\(^3\) The time between setting a new NO set point and the patient receiving it.
The NOxBOXO₂ is the flagship of NO monitoring, allowing accurate, real-time monitoring of not only NO and NO₂ but also Oxygen (O₂) levels. This additional feature enables the user to monitor the exact concentration of O₂ entering the patient, as this is often different from that indicated on the ventilator once dilution with NO has occurred.
The internal pump ensures that the sensor is constantly exposed to constant gas pressure and flow rate, enabling the NOxBOXO$_2$ to be used with all ventilators and spontaneous breathing patients.

The NOxBOXO$_2$ features alarms that can be adjusted to suit the range being used, these alarms include:

- Low NO – to prevent sudden cessation of NO delivery
- High NO – warning for potential over dosage of NO
- High NO$_2$ – avoiding NO$_2$ poisoning
- Low O$_2$ – to ensure correct concentration of O$_2$

Compatible with all ventilators, using a low cost connection kit (NOXKIT-V)

**Order Code – NOXBOXO$_2$**

**Technical Specification**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring Range:</td>
<td>0-99.9 ppm NO</td>
</tr>
<tr>
<td></td>
<td>0-19.9 ppm NO$_2$</td>
</tr>
<tr>
<td></td>
<td>0-100% O$_2$</td>
</tr>
<tr>
<td>Sample Flow Rate:</td>
<td>Approx. 250 ml/min</td>
</tr>
<tr>
<td>Mode of operation:</td>
<td>Continuous</td>
</tr>
<tr>
<td>Detection Principle:</td>
<td>Sealed Electrochemical Sensor</td>
</tr>
<tr>
<td>Accuracy:</td>
<td>&lt;5% of reading</td>
</tr>
<tr>
<td>Display:</td>
<td>Graphical LCD</td>
</tr>
<tr>
<td>Alarms:</td>
<td>Audible and visible</td>
</tr>
<tr>
<td>Warm Up Time:</td>
<td>&lt;2 minutes</td>
</tr>
<tr>
<td>Response Time:</td>
<td>&lt;10 secs to 90% FSD NO</td>
</tr>
<tr>
<td></td>
<td>&lt;30 secs to 90% FSD NO$_2$</td>
</tr>
<tr>
<td>Operating Temperature:</td>
<td>10-40°C</td>
</tr>
<tr>
<td>Operating humidity:</td>
<td>30-75%</td>
</tr>
<tr>
<td>Transport/Storage temperature:</td>
<td>10-40°C</td>
</tr>
<tr>
<td>Transport/Storage humidity:</td>
<td>30-75%</td>
</tr>
<tr>
<td>Sensor Operating Life:</td>
<td>1-2 years</td>
</tr>
<tr>
<td>Sensor Resolution:</td>
<td>0.1 ppm NO and NO$_2$</td>
</tr>
<tr>
<td>Power input:</td>
<td>230v, 50Hz/60Hz, 110mA (optional) 115v, 60Hz, 220mA</td>
</tr>
<tr>
<td>Battery Life (approx.):</td>
<td>4-6 hours (operational, no alarms)</td>
</tr>
<tr>
<td></td>
<td>1 Year (storage)</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>240(D) x 210(W) x 140(H) mm</td>
</tr>
<tr>
<td>Weight:</td>
<td>Approx 4kg including batteries</td>
</tr>
<tr>
<td>Construction:</td>
<td>Aluminium</td>
</tr>
</tbody>
</table>
NOxBOX®mobile

Complete NO delivery and monitoring system

Space for dual cylinders, allowing for constant NO delivery with automatic switchover when one is empty.

Cylinder pressure gauges showing constant gas levels, to prevent sudden cessation of treatment.

Portable, visual and audio alarms warn staff if environmental levels of NO and NO₂ rise above occupational safety limits. See page 12.

Can be used with the NOxBOXO₂ INO monitor.

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The NOxBOX® mobile is a completely self contained NO delivery and monitoring system. Allowing NO to be deployed, monitored quickly and used easily close-by the patient’s ventilator, as research shows that hoses containing NO/O₂ mixtures must be kept as short as possible in order to limit the build up of NO₂. NOxBOX Ltd recommend 1m from dose.

We recommend the use of NOxBOXO₂ with NOxBOX mobile due to the extra advantage of O₂ monitoring. The monitors are both mains powered with back up batteries for emergencies or transportation.

The NOxBOX mobile can be used with different suppliers of NO medical gas products to suit preferences.

Compatible with all continuous flow ventilators and spontaneous breathing patients if NOxBOXO₂ is used.

The use of environmental NO and NO₂ monitors are recommended when delivering NO. See page 12.

Order Code – NOXDCO2

Technical Specification

<table>
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<th>Specifications</th>
<th>Details</th>
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</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>1590(H) x 500(W) x 528(D) mm</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 40kg complete trolley and cylinders</td>
</tr>
<tr>
<td>Construction</td>
<td>Powder coated steel</td>
</tr>
<tr>
<td>Wheels</td>
<td>75mm anti-static castors, with kick-stop lock</td>
</tr>
<tr>
<td>Flow meters</td>
<td>10-100cc/min and 60-600cc/min</td>
</tr>
<tr>
<td>Regulators</td>
<td>Single stage, stainless steel, 2 bar max. outlet</td>
</tr>
<tr>
<td>Changeover</td>
<td>Regulator stainless steel</td>
</tr>
<tr>
<td>Storage Conditions</td>
<td>Dry, clean atmosphere, between 0 and 40°C</td>
</tr>
<tr>
<td>Dynamic bend radius</td>
<td>200mm</td>
</tr>
</tbody>
</table>
The NOxBOX-lite™ is an extremely easy to use, simple inhaled nitric oxide (INO) delivery system. Using state-of-the-art digital, mass flow technology the NOxBOX-lite™ can be used accurately in any orientation, with over 2 years replaceable, battery life. High precision, adjustable needle valves are used to ensure far superior accuracy compared to traditional flow meters. This all makes the NOxBOX-lite™ perfect for emergency and transport situations where space and time are in short supply.

In addition to the digital flow meter, NOxBOX Ltd have specifically designed a compact, hand tighten regulator, reducing up to 200bar (2900.7psi) of pressure down to 4bar (58.0psi) ensuring safety for both the user and the patient.
It is mandatory to monitor INO delivery to safely treat patients so used with the NOxBOX Ltd NOxBOXO₂™ the NOxBOXlite™ becomes a simple but effective INO delivery and monitoring system.

**Intended Use**
The NOxBOXlite™ is intended to be used for emergency or transport purposes, when the delivery to a patient is limited to a short time. The NOxBOXlite™ is intended to administer Nitric Oxide (NO) to the breathing circuits of patients undergoing Inhaled NO Therapy. The NOxBOXlite™ is intended to be used in conjunction with an Inhaled NO Therapy monitor.

Nitric Oxide (NO) is administered as a selective pulmonary vasodilator for conditions such as:
- Persistant pulmonary hypertension in new-born babies
- Adult respiratory distress syndrome (ARDS)
- For acute post-operative cardiac patients

Equipment should only be used by suitably trained and qualified health professionals.

**Technical Specification**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flow Range</td>
<td>25 – 2000 cc/min</td>
</tr>
<tr>
<td>Accuracy 25 – 2000 cc/min</td>
<td>±5% of full scale</td>
</tr>
<tr>
<td>Response time</td>
<td>from 500 ms</td>
</tr>
<tr>
<td>Repeatability</td>
<td>±5% from measurement value</td>
</tr>
<tr>
<td>Power</td>
<td>Lithium Battery</td>
</tr>
<tr>
<td>Battery Life</td>
<td>2 years</td>
</tr>
<tr>
<td>Operating pressure</td>
<td>0.2 to 11 bar (2.9 to 159.5 psi)</td>
</tr>
<tr>
<td>Regulator inlet pressure</td>
<td>Max 200 bar (2900.7 psi) min 20 bar(290.7 psi)</td>
</tr>
<tr>
<td>Regulator outlet pressure</td>
<td>4 bar (58.0 psi)</td>
</tr>
<tr>
<td>Operating temperature</td>
<td>10 – 35ºC</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>0 – 40ºC</td>
</tr>
<tr>
<td>Storage humidity</td>
<td>15 - 85%</td>
</tr>
<tr>
<td>Warm-Up time</td>
<td>&lt;1 sec for full accuracy</td>
</tr>
<tr>
<td>Display</td>
<td>6-digit LCD in engineering unit's and bar graph</td>
</tr>
<tr>
<td>Weight</td>
<td>Approx. 1.25 kg</td>
</tr>
<tr>
<td>Dimensions</td>
<td>85(H) x 220 (W) x 80 (D) mm</td>
</tr>
</tbody>
</table>

**Note:** Specification details may still be subject to some changes. Overall operation character should be similar to above, but design is not fixed and final.
Optional Extras

Manual Bagging System
at the turn of a switch the NOxBOX mobile can be switched from the ventilator to manual bagging for emergency transportation situations or other non-ventilated procedures.
Order Code - NOXBAG

NOxAIR Portable, visual and audio alarms warn staff if environmental levels of NO and NO₂ rise above occupational safety limits and detect leaks.
Order Codes – NOXAIR-NO-V
    NOXAIR-NO2-V

Soft carry case for transportation of up to 2 high capacity calibration cylinders used for NOxBOX calibration.
Order Code – SCCG

034-18-00520-V (Calibration gas - 25ppm NO in N2. 34ltr disposable cylinder, filled with 27ltr gas).
034-20-01010-V (Calibration gas - 10ppm NO₂ in Air. 34ltr disposable cylinder, filled with 27ltr gas).
REGSS-1.0-V (Gas regulator stainless steel for calibration gas 1ltr/min flow)
NOX-Y-CAL (Calibration tubing and Y-Piece)