

# INOvent<sup>®</sup> delivery system

FOR NITRIC OXIDE THERAPY

## INOvent application update #9

### 1) Are environmental levels of NO and NO<sub>2</sub> a concern when using inhaled Nitric Oxide.

The National Institute for Occupational Safety and Health (NIOSH) Recommendations for Occupational Safety and Health Standards 1988 (reference 1 below) are:

NO Recommended Exposure Limit (NIOSH)  
25 ppm time weighted average.

NO<sub>2</sub> Recommended Exposure Limit (NIOSH)  
1 ppm ceiling.

Typical ICU environments have 6 room air exchanges per hour and this provides significant dilution of any NO/NO<sub>2</sub> gas leaving the ventilator. A simple calculation illustrates the dilution effect of air exchanges;

Room dimensions in meters 3 (H) x 7 (L) x 5 (W) =  
105 m<sup>3</sup> volume.

Ventilation rate at 6 exchanges / hour =  
10,500 L/min.

If the NO flow from the ventilator in to the room is  
40 ppm at 10 L/min.

The average room concentration of NO will be  
 $40 \times 10 / 10,500 = 0.04$  ppm NO.

This value is orders of magnitude lower than the  
NIOSH recommendations.

Hess et al (reference 2 below) measured ambient NO and NO<sub>2</sub> levels during NO delivery at 100 ppm and at 8 L/min with no gas scavenging and found average NO levels of 0.05 ppm and average NO<sub>2</sub> levels of 0.025 ppm. Both of these values being orders of magnitude lower than the NIOSH recommendations.

#### Conclusion

As long as inhaled NO is used in well ventilated ICU rooms, the environmental levels of NO and NO<sub>2</sub> will be well below the recommended levels for occupational health and safety.

If a hospital determines that scavenging of the ventilator exhaust gas is required, they should use a scavenging device recommended by the ventilator manufacturer to avoid possible malfunction of the ventilator.

#### References

- Centers for Disease Control, Atlanta, Georgia 30333 USA. NIOSH Recommendations for Occupational Safety and Health Standards. MMWR Supplement Aug 26 1988; 37; No 9.
- Hess, D. Bigatello, L. Macmarek R.M. Ritz, R. Head, A. and Hurford W.E. Use of Inhaled Nitric Oxide in patients with Acute Respiratory Distress Syndrome, Respiratory Care, 1996, vol 41, number 5, page 424-446.

## 2) Does acid form in the humidifier or breathing circuit when delivering inhaled Nitric Oxide.

A long term test was performed at Datex-Ohmeda to determine if acid would build up in a breathing circuit over time when delivering inhaled Nitric Oxide.

The test equipment was a *Sechrist IV-100B* neonatal ventilator and a *Fisher Paykel MR500* humidifier. The ventilator settings were Rate 40 breaths per minute, Flow 6 L/min and Oxygen 100% v/v and the humidifier was set to 36 degree's C.

The pH level was measured at the humidifier (the water in the humidifier chamber), at the patient Y (the condensate in the breathing circuit) and at the exhalation valve back at the ventilator (the condensate in the breathing circuit).

Distilled water was used for the test which had an initial pH of 5.75 and the pH was measured with Hydrion Paper (4.5 to 7.5).

A control test without NO being delivered was run initially to see if the pH would changed over time due to the slightly acidic nature of distilled water. The control test was run for 6 days with no change in the pH at any of the test points.

The test was then repeated with 80 ppm of NO being delivered continuously for 9 days with the pH being tested daily at each of the test points. There was no change of pH at any of the test points for any of the daily tests.

### Conclusion

Nitric Oxide does not effect the pH level in the breathing circuit or the humidifier chamber when tested with the extreme test conditions of high NO setting of 80 ppm NO and a low gas flow rate of 6 L/min of 100% oxygen.



**Datex-Ohmeda Division** • Instrumentarium Corp.  
P.O. Box 900, FIN-00031 Datex-Ohmeda, Finland  
Tel. +358 10 394 11 • Fax +358 9 146 3310

[www.datex-ohmeda.com](http://www.datex-ohmeda.com)



Datex-Ohmeda, Inc.  
Ohmeda Drive, P.O. Box 7550, Madison, WI 53707-7550, USA  
Tel. 800 345 2700 • Fax 608 222 9147