The Air*Life*™ Bypass HME moisture output

Introduction

The moisture-conserving performances of the Air*Life*™ Bypass HMEs were quantified with the 2000 standard[1] measuring moisture loss. The 1992 standard[2] quantifies moisture output, and is the method that was used to quantify the moisture-conserving performances of many existing HMEs.

Purpose

The differences between the two standards will be compared and contrasted, and a method for deriving moisture output results from moisture loss results will be presented.

Discussion

Moisture output and moisture loss are related for each test condition. The relationship is given below[3]:

(Saturated absolute humidity) mg/L – (moisture loss) mg/L =
(moisture output) mg/L

The formula has been derived from the moisture output formula presented in ISO 9360:1992, utilizing "saturated absolute humidity" for the correction factor and a calibrated HME per the 2000 standard.

Conclusion

There are differences between the 1992 and 2000 standards for quantifying moisture-conserving performance. A method for deriving moisture output results from moisture loss results was presented, and can be used for comparative evaluation.

BS EN ISO 9360-1:2000 and ISO 9360:1992 have differences in the test methods. Differences between the two methods include:

	ISO 9360:1992		BS EN ISO 9360-1:2000	
		Reference		Reference
Water temp:	34˚C	6.1.3	37˚C	6.2.4.3
Saturated absolute humidity (mg/L):	37.7	34˚C	44.1	37˚C
I:E Ratio (>50 mL):	1:2	Table 2	1:1	Table 2
500 mL bpm:	20	Table 2	15	Table 2
Quantified:	Moisture output		Moisture loss	

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The moisture output for the Air*Life*™ Bypass HMEs can be calculated utilizing the formula provided. The Air*Life*™ Bypass HMEs were tested utilizing the 2000 standard[4], with a saturated absolute humidity of 44.1 mg/L.

003020 Air*Life*™ Adult Nonfiltered Bypass HME Saturated					
Tidal volume	Absolute humidity		Moisture loss		Moisture output
250 mL	44.1	–	9.1	=	35.0
500 mL	44.1	–	10.6	=	33.5
750 mL	44.1	–	12.9	=	31.2
1000 mL	44.1	–	14.3	=	29.8
1250 mL	44.1	–	14.9	=	29.2

003021 Air*Life*™ Adult Filtered Bypass HME Saturated					
Tidal volume	Absolute humidity		Moisture loss		Moisture output
250 mL	44.1	–	8.7	=	35.4
500 mL	44.1	–	11.1	=	33.0
750 mL	44.1	–	12.9	=	31.2
1000 mL	44.1	–	14.7	=	29.4
1250 mL	44.1	–	15.7	=	28.4

Saturated absolute humidity

Absolute humidity values for saturated air at various temperatures are provided below[5]:

Temperature (˚C)	Absolute humidity (mg/mL)
34	37.7
35	39.8
36	41.9
37	44.1

Terms and definitions

HME moisture loss: the total amount of water lost from the test apparatus when tested as specified. This moisture loss estimates the moisture lost from the "patient".

HME moisture output: the total amount of water, in milligrams per liter, of inspired gas leaving the HME patient port, under the specified test conditions. The moisture output estimates the moisture delivered to the "patient".

Saturated absolute humidity: the ratio of the maximum mass of water vapor to total volume of the sample for a given temperature.

HME: a generic term for heat and moisture exchanger, and includes simple condenser humidifiers, hygroscopic condenser humidifiers, and hydrophobic condenser humidifiers.

[1] BS EN ISO 9360-1:2000, Anaesthetic and respiratory equipment – Heat and moisture exchangers (HMEs) for humidifying respired gases in humans – Part 1: HMEs for use with minimum tidal volumes of 250 mL.

[2] ISO 9360:1992, Anaesthetic and respiratory equipment – Heat and moisture exchangers for use in humidifying respired gases in humans.

[3] Wilkes, A. R., The moisture-conserving performance of breathing system filters in use with simulated circle anaesthesia breathing systems, *Anaesthesia* 2004, 59, p. 276.

[4] Moisture Loss testing was conducted under CareFusion Protocol RT-08-041.

[5] Calculated utilizing the Psychrometric Analysis CD, Version 6.1.52, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE), 1791 Tullie Circle NE, Atlanta, GA 30329 USA. Calculations based on 760 mmHg pressure and 100% Relative Humidity.

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