Information for Clinical Choice Matrix and Support Document

Heat and Moisture Exchanger

Information for Clinical Choice (ICC) has been developed to assist clinicians in the decision-making process when assessing the suitability of a product by providing a clear illustration and description of the features of a range of similar products supplied through NHS Supply Chain. The criteria provided, in the form of a Product Matrix and Support Document, is the result of a product review, conducted by DHLs Clinical Collaboration Team (CCT), with support from clinical stakeholders from across the NHS.

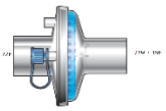
The aim, alongside delivering savings back into NHS frontline services, is to ensure that clinical choice remains at the forefront of any product switching decision.

Airways Management: Heat and Moisture Exchanger

These conserve heat and moisture during expiration and make this available to inspired gases during subsequent inspiration. Heat and Moisture Devices, including those that incorporate a breathing filter are tested against the international standard ISO 9360-1:2000(E).[2]

Why is Humidification needed?

The gases generally available for medical use lack sufficient moisture to be physiologically acceptable to the respiratory tract of patients. Heat and Moisture exchangers are used to raise the water content and the temperature of a gas delivered to the respiratory tract. [2]

HME Ported				
Supplier	**Draeger**	**Intersurgical**	**Intersurgical**	**Meditech**
MPC	MP01730	1560000	1855000	222835HME
NPC	FDC840	FTC170	FTC118	FSM7403
Description	HME Adult Ported Straight	HME Adult Ported Straight	HME Adult Ported Straight	HME Adult Ported Straight
Picture				
UOI	50	150	20	50
Stocked	Blue Diamond	Stocked	Stocked	Blue Diamond
Recommended max duration of use	24 Hours	24 Hours	24 Hours	7 Days
Internal volume	55 ml	59 ml	20 ml	32 ml
Hydrophobic filter	×	×	×	×
Mass of moisture loss of the HME (mgH2O/L @ Vt 500ml)	6.3	6.7	7.8	6.3
Mass of moisture output of the HME (mgH2O/L @ Vt 500ml)	37.7	31.6	30.8	32
HME has a tethered cap	✓	✓	✓	✓
Tidal volumes (VT)	300 ml – 1500 ml	>200 ml	>60 ml	120 ml-1200 ml
Latex-free	✓	✓	✓	✓
Sterile	×	✓	✓	×
Breathing system port 22F/15M	✓	✓	15M	✓
Patient connection port 22M/15F	✓	✓	✓	✓
Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O)	1.0 / Not available	0.2 / 0.3	0.5 / 1.0	1.4 / 1.4
Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O)	2.0 / Not available	0.7 / 0.7	1.6 / 2.9	2.0 / 2.0
Country of manufacture	China/Germany	UK	Lithuania	UK

HME Non-Ported						
Supplier	**Intersurgical**	**Smiths Medical**	**Smiths Medical**	**Teleflex**	**Vyaire**	**Vyaire**
MPC	1850000	100/580/015	100/582/000	11111	003003	557055200
NPC	FDB1020	FTC047	FTC076	FTC013	FDC1342	FTC301
Description	HME Adult Non-Ported Straight	HME Adult Non-Ported Straight	HME Adult Non-Ported Straight	HME Adult Non-Ported Straight	HME Adult Non-Ported Straight	HME Adult Non-ported Straight
Picture						
UOI	20	20	20	50	50	30
Stocked	Stocked	Stocked	Blue Diamond	Stocked	Blue Diamond	Blue Diamond
Recommended max duration of use	24 Hours	24 Hours	24 Hours	24 Hours	24 Hours	24 Hours
Internal volume	20 ml	11 ml	32 ml	10 ml	31 ml	28 ml
Hydrophobic filter	✗	✗	✗	✓	✗	✓
Mass of moisture loss of the HME (mgH2O/L @ Vt 500ml)	7.8	14.7	8	Not available	9	7.5 @Vt 750 ml
Mass of moisture output of the HME (mgH2O/L @ Vt 500ml)	30.8	27	22	29 - 24	Not available	30 @ Vt 750 ml
Tidal volumes (VT)	>60 ml	<600 ml	600 ml	50 ml – 600 ml	150 ml - 1250 ml	110 ml – 1000 ml
Product is latex free	✓	✓	✓	✓	✓	✓
Sterile	✓	✓	✓	✗	✗	✗
Breathing system port 22F/15M	15M	15M	15M	15M	15M	15F (only)
Patient connection port 22M/15F	✓	22M	22M	✓	Not available	15M/15F
Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O)	0.5 / 1.0	1.0 / Not available	0.4 / Not available	0.68 / 0.76	1.0 / Not available	1.1 / Not available
Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O)	1.6 / 2.9	1.0 / Not available	0.12 / Not available	1.8 / 1.84	2.5 / Not available	2.5 / Not available
Country of manufacture	Lithuania	Mexico	Mexico	Malaysia	Not available	Not available

Breathing Filters

Bacterial/Viral filters are intended to help prevent the transmission of bacteria and viruses and prevent cross infection to and from the patient during anaesthesia or other types of ventilation

The British Standards defines breathing filters as, “devices intended to reduce transmission of particulates, including micro-organisms, such as bacteria and viruses to prevent cross infection to and from the patient during anaesthesia or other types of ventilation”.[2]

Heat Moisture Exchangers (HME)

These conserve heat and moisture during expiration and make this available to inspired gases during subsequent inspiration. Heat and Moisture Devices, including those that incorporate a breathing filter are tested against the international standard ISO 9360-1:2000(E).[2]

HME’s can be used as part of a passive humidification breathing system for mechanically ventilated patients
The HME is designed to replicate the functions of the upper airway conserving the patient’s own expired heat and moisture and returning these to the patient during inspiration.

Heat and Moisture Exchange Filters (HMEF)

HMEF’s are a combination of an HME and Breathing Filter to achieve both clinical outcomes of filtration and heat and moisture exchange.

HEPA Filter

HEPA filtration works by mechanical means and stands for High Efficiency Particulate Air.
The HEPA filter standard to remove at least 99.97% of particles from the air down to at least 0.3 microns in size.[9]

Filter Attributes

Electrostatic Filters

Electrostatic filter material has an electrostatic charge applied to attract and capture charged particles. These are tested using the most penetrating particle size (MPPS) range of 0,1 µm to 0,3 µm. For electrostatic filter material, the density of fibres is comparatively low and the electrostatic charge on the fibres.

For circle breathing systems where low fresh gas flow techniques are used, the use of electrostatic filters cannot be recommended as there is a risk of transmission of contaminated liquid from the breathing system directly into the patient’s airway.[6]

Mechanical Filters

Mechanical filter has a densely packed resin-bonded, hydrophobic glass fibres, this mechanical filter physically stops and capture particles.

Mechanical filters are mainly pleated to reduce resistance to gas flow. This type of sheet is **hydrophobic** and, under normal conditions, does not absorb water. These are tested using the most penetrating particle size
(MPPS) range of 0,1 µm to 0,3 µm. The efficiency of a mechanical filter is determined by its physical features, for example diameter, orientation and arrangement of fibres.[2]

Dead space

Heat and moisture exchangers and filters add to the dead space of the breathing system when they are connected between the patient and the breathing system, so that a greater proportion of the exhaled carbon dioxide is returned in the next breath.
This is identified through the size of the **internal volume** of the HME(F) or breathing filter.
Generally, the dead space of the bacterial/viral filter should be as small as possible in order that no detriment to the work of breathing is experienced by the patient. For some patients with small lung volumes (young children or patients with severe pulmonary disease), it is even more important that the dead space is reduced to its minimum.[5]

Mass of moisture loss

The manufacturer or supplier must supply the moisture loss, in milligrams water per litre of air and expressed to the nearest milligram as tested by stated ISO test conditions. These are within the operating range of the HME as specified by the manufacturer, and at the minimum and maximum tidal volumes recommended by the manufacturer, this is to avoid the inspissation (thickening) of secretions.[2, 6]

Mass of moisture output

Heat and moisture output during expiration and made available / returned to inspired gases during subsequent inspiration.

Filter resistance

- Filter resistance is dependent on the flow rate used.
- Most filters were tested in adults using a flow rate of 60 litre per min, but flow rates of about 30 litre min, were used for several filters, so that comparisons are difficult.
- Filters can be tested both pre and post conditioning, this means that the filters are tested dry and unused, but then also tested saturated which simulates their performance during use.
- Most of the HMEF on the NHS Supply Chain catalogue have a reasonable low-resistance (0.8–3.6 cm H2O for a gas-flow rate of 60 litre per min.
- Low resistance can be paramount for clinical management of certain conditions and treatments for example Non-invasive ventilation to decrease the resistance of the breathing system for patients who may already be respiratory distressed the lower the resistance the better, usually under 1.5cm H2O.[5]

References:

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3. BS EN ISO 23328-2:2009. Breathing system filters for anaesthetic and respiratory use. Part 2: Non-filtration aspects (ISO 23328-2:2002)

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5. Cramer,D. &Ward,S. BACTERIAL/VIRAL FILTERS IN PULMONARY FUNCTION DEPARTMENTS. Accessed 24th July 2020. http://www.wales.nhs.uk/sitesplus/documents/861/bacterial%20viral%20filter%20info.pdf

6. Wilkes, A.R. 2010. Heat and moisture exchangers and breathing system filters: their use in anaesthesia and intensive care. Part 1 – history, principles and efficiency. Accessed 24th July 2020. https://onlinelibrary.wiley.com/doi/full/10.1111/j.1365-2044.2010.06563.x

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9. European Standard EN 1822-1:2009, "High efficiency air filters (EPA, HEPA and ULPA)", 2009

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