

Information for Clinical Choice Matrix and Support Document

Breathing Filters

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: Breathing Filters

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






| Electrostatic Ported (Part 1) | | | | | | | | | |
|---|---|---|---|--|---|---|---|---|---|
| Supplier | Draeger | Draeger | Draeger | Flexicare Medical | Intersurgical | Intersurgical | Intersurgical | Intersurgical | Intersurgical |
| MPC | MP01755 | MP01765 | MP01770 | 038-41-365 | 1644000 | 1544000 | 1944003 | 1544197 | 1545000 |
| NPC | FTC1993 | FDC838 | FDB1060 | FSM3945 | FTC112 | FTC168 | FTC135 | FDB937 | FAG4861 |
| Description | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Angled | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Angled |
| Picture |  |  |  |  |  |  |  |  |  |
| Stocked | Blue Diamond | Blue Diamond | Blue Diamond | E-Direct | Stocked | Stocked | Stocked | Stocked | Stocked |
| Recommended max duration of use | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours |
| Internal volume | 45 ml | 45 ml | 30 ml | 66 ml | 34 ml | 60 ml | 67 ml | 60 ml | 75 ml |
| Hydrophobic filter | * | * | * | * | ✓ | ✓ | ✓ | ✓ | ✓ |
| HME has a tethered cap | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Tidal volumes (VT) | 300ml – 1500ml | 300ml - 1500ml | 300ml - 1500ml | >198ml | >100ml | >200ml | >200ml | >200ml | >225ml |
| Product is latex free | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sterile | * | * | * | * | ✓ | ✓ | ✓ | * | * |
| Breathing system port 22F/15M | ✓ | ✓ | ✓ | ✓ | 22F (only) | ✓ | 22F (only) | ✓ | ✓ |
| Patient connection port 22M/15F | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O) | 0.7 / Not available | 1.0 / Not available | 1.0 / Not available | 1.2 / Not available | 0.7 / Not available | 0.8 / Not available | 1.02 / Not available | 0.9 / Not available | 0.8 / Not available |
| Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O) | 2.0 / Not available | 3.0 / Not available | 3.0 / Not available | 3.5 / Not available | 1.8 / Not available | 1.9 / Not available | 2.48 / Not available | 2.4 / Not available | 2.1 / Not available |
| HEPA filtration | * | * | * | * | * | * | * | * | * |
| Filtration performance rate as per ISO 23328-1 (salt test) | > 98% | > 98% | > 95% | 98.9% | 97.61% | 98.32% | 99.89% | 98.32% | 98.21% |
| Country of Manufacture | China/Germany | China/Germany | China/Germany | China | UK | UK | Lithuania | UK | Lithuania |











| Electrostatic Ported (Part 2) | | | | | | | | | |
|---|---|---|---|--|---|---|---|---|---|
| Supplier | Teleflex | Teleflex | Teleflex | Teleflex | Teleflex | Teleflex | Teleflex | Teleflex | Vyaire |
| MPC | 18211T | 18212T | 18511 | 18512T | 19211 | 19212T | 19511 | 19512T | 557022500 |
| NPC | FTC343 | FTC1989 | FDC1233 | FTC566 | FDC1232 | FDC3559 | FDC3580 | FTC560 | FDC850 |
| Description | Breathing Filter Adult Electrostatic Ported Angled | Breathing Filter Adult Electrostatic Ported Angled | Breathing Filter Adult Electrostatic Ported Angled | Breathing Filter Adult Electrostatic Ported Angled | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight | Breathing Filter Adult Electrostatic Ported Straight |
| Picture |  |  |  |  |  |  |  |  |  |
| Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Blue Diamond |
| Recommended max duration of use | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours |
| Internal volume | 30 ml | 30 ml | 21 ml | 31 ml | 26 ml | 26 ml | 20 ml | 29 ml | 35 ml |
| Hydrophobic filter | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ |
| HME has a tethered cap | ✓ | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✓ |
| Tidal volumes (VT) | 150ml - 1000ml | 150ml - 1000ml | 150ml - 1000ml | 150ml - 1000ml | 150ml - 1000ml | 150ml - 1000ml | 150ml - 1000ml | 150ml - 1000ml | Not available |
| Product is latex free | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sterile | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ |
| Breathing system port 22F/15M | ✓ | ✓ | 15M (only) | 15M (only) | ✓ | ✓ | 15M (only) | 15M (only) | ✓ |
| Patient connection port 22M/15F | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O) | 0.84 / 0.84 | 0.84 / 0.84 | 1.36 / 1.36 | 1.36 / 1.36 | 0.84 / 0.84 | 0.84 / 0.84 | 1.36 / 1.36 | 1.36 / 1.36 | 0.7 / Not available |
| Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O) | 2.02 / 2.01 | 2.02 / 2.01 | 3.14 / 3.14 | 3.14 / 3.14 | 2.02 / 2.01 | 2.02 / 2.01 | 3.14 / 3.14 | 3.14 / 3.14 | 0.8 / Not available |
| HEPA filtration | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ | ✗ |
| Filtration performance rate as per ISO 23328-1 (salt test) | 95.89% | 95.89% | 86.24% | 86.24% | 95.89% | 95.89% | 86.24% | 86.24% | Not available |
| Country of Manufacture | Malaysia | Malaysia | Malaysia | Malaysia | Malaysia | Malaysia | Malaysia | Malaysia | Not available |




| Electrostatic Non-ported | | | | | | | | | | | |
|---|--|--|--|--|--|--|--|--|--|--|--|
| Supplier | Flexicare Medical | Intersurgical | Intersurgical | Intersurgical | Intersurgical | Intersurgical | Meditech | Vyaire | Vyaire | Vyaire | Vyaire |
| MPC | 038-41-360 | 1690000 | 1944000 | 1544007 | 1344007S | 1644007 | 222832 | M1003346 | 557021200 | 001851 | 001853 |
| NPC | FTC174 | FTC500 | FTC038 | FTC465 | FDC889 | FDB973 | FTC1992 | FDD5256 | FDC851 | FDC1280 | FDC1281 |
| Description | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight | Breathing Filter Adult Electrostatic Non-Ported Straight |
| Picture | | | | | | | | | | | |
| UOI | 50 | 50 | 70 | 150 | 50 | 100 | 50 | 50 | 45 | 15 | 50 |
| Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Stocked | Blue Diamond | Blue Diamond | Blue Diamond | Blue Diamond |
| Recommended max duration of use | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 7 Days | 24 Hours | 24 Hours | 24 Hours | 24 Hours |
| Internal volume | 66 ml | 80 ml | 67 ml | 60 ml | 41 ml | 34 ml | 30 ml | 35 ml | 27 ml | 43 ml | 59 ml |
| Hydrophobic filter | * | ✓ | ✓ | ✓ | ✓ | ✓ | * | * | * | * | * |
| Tidal volumes (VT) | >198ml | >80ml | >200ml | >200ml | >150ml | 100ml | 120ml - 1200ml | Not available | Not available | Not available | Not available |
| Product is latex free | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sterile | * | ✓ | ✓ | * | ✓ | * | ✓ | * | * | * | * |
| Breathing system port 22F/15M | ✓ | 22F (only) | 22F (only) | ✓ | ✓ | 22F (only) | 22F (only) | ✓ | 22F (only) | - | 22F (only) |
| Patient connection port 22M/15F | ✓ | 22M (only) | ✓ | ✓ | ✓ | ✓ | 15M (only) | ✓ | ✓ | - | ✓ |
| Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O) | 1.2 / Not available | 0.38 / Not available | 1.0 / Not available | 0.9 / Not available | 0.8 / Not available | 0.7 / Not available | 1.0 / 1.0 | 0.8 / Not available | 0.4 / Not available | 0.54 / Not available | 1.2 / Not available |
| Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O) | 3.5 / Not available | 0.81 / Not available | 2.31 / Not available | 1.9 / Not available | 2.1 / Not available | 1.8 / Not available | 1.0 / 1.0 | 1.9 / Not available | 3.2 / Not available | 2.8 / Not available | Not available |
| HEPA filtration | * | * | * | * | * | * | * | * | * | * | * |
| Filtration performance rate as per ISO 23328-1 (salt test) | 98.9% | 99.24% | 99.89% | 98.32% | 98.09% | 97.61% | 98.9% | Not available | Not available | Not available | Not available |
| Country of Manufacture | China | Lithuania | Lithuania | UK | Lithuania | UK | UK | Not available | Not available | Not available | Not available |

| Mechanical Ported (Part 1) | | | | | | |
|---|---|---|---|--|---|---|
| Supplier | Draeger | Draeger | Draeger | Flexicare Medical | HC21 | HC21 |
| MPC | MP01785 | MP01795 | MP01790 | 038-41-375 | 351/5410TC | 351/5979TC |
| NPC | FDB694 | FDC837 | FTC2012 | FSM4196 | FTC206 | FTC208 |
| Description | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Angled | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight |
| Picture |  |  |  |  | | |
| UOI | 50 | 50 | 50 | 50 | 25 | 25 |
| Stocked | Blue Diamond | Blue Diamond | Blue Diamond | E-Direct | Stocked | Stocked |
| Recommended max duration of use | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours |
| Internal volume | 80 ml | 60 ml | 55 ml | 47 ml | 66 ml | 42 ml |
| Hydrophobic filter | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| HME has a tethered cap | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Tidal volumes (VT) | 300ml - 1500ml | 300ml - 1500ml | 300ml - 1500ml | >141ml | 300ml - 1500ml | 150ml - 1200ml |
| Product is latex free | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sterile | ✗ | ✗ | ✗ | ✗ | ✓ | ✓ |
| Breathing system port 22F/15M | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Patient connection port 22M/15F | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O) | 2.0 / Not available | 2.0 / Not available | 2.0 / Not available | 1.7 / Not available | 0.8 / 0.8 | 1.2 / 1.4 |
| Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O) | 4.0 / Not available | 4.0 / Not available | 4.0 / Not available | 3.8 / Not Available | 2.0 / 2.0 | 2.7 / 2.8 |
| HEPA filtration | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ |
| Filtration performance rate as per ISO 23328-1 (salt test) | > 99% | > 99% | > 99% | 99.99% | Not available | Not available |
| Country of Manufacture | China/Germany | China/Germany | China/Germany | China | Not available | Not available |



| Mechanical Ported (Part 2) | | | | | | | | |
|---|---|---|---|--|---|---|---|---|
| Supplier | Intersurgical | Intersurgical | Pall Medical | Pall Medical | Pall Medical | Teleflex | Teleflex | Teleflex |
| MPC | 1745000 | 1745197 | BB25 | BB100PF | BB25F | 28001T | 28051 | 28061 |
| NPC | FTC113 | FTC451 | FTC633 | FDC1466 | FDC1465 | FTC349 | FDC3576 | FDC3577 |
| Description | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Straight | Breathing Filter Adult Mechanical Ported Angled | Breathing Filter Adult Mechanical Ported Straight |
| Picture |  |  |  |  |  |  |  |  |
| UOI | 40 | 50 | 50 | 50 | 50 | Box 20 | Box 25 | Box 25 |
| Stocked | Stocked | Stocked | Blue Diamond/ Stocked | Blue Diamond/ Stocked | Blue Diamond/ Stocked | Stocked | Stocked | Stocked |
| Recommended max duration of use | 24 Hours | 24 Hours | 24 Hours | 48 Hours | 24 Hours | 24 Hours | 24 Hours | 24 Hours |
| Internal volume | 63 ml | 63 ml | 35 ml | 85 ml | 35 ml | 80 ml | 31 ml | 29 ml |
| Hydrophobic filter | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| HME has a tethered cap | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✗ | ✗ |
| Tidal volumes (VT) | >200 ml | >200ml | > 100 ml | > 150 ml | > 100 ml | 300ml - 1200ml | 150ml - 1000ml | 150ml - 1000ml |
| Product is latex free | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sterile | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | ✓ | ✓ |
| Breathing system port 22F/15M | ✓ | ✓ | ✓ | 22F (only) | ✓ | ✓ | 15M (only) | 15M (only) |
| Patient connection port 22M/15F | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O) | 1.3 / Not available | 1.59 / Not available | 1.5 / 1.5 | 1.0 / 1.0 | 1.5 / 1.5 | 1.03 / 1.03 | 2.11 / 2.11 | 2.11 / 2.11 |
| Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O) | 2.89 / Not available | 3.97 / Not available | 3.5 / 3.5 | 2.5 / 2.5 | 3.5 / 3.5 | 2.31 / 2.30 | 4.60 / 4.58 | 4.60 / 4.58 |
| HEPA filtration | ✗ | ✗ | ✗ | ✗ | ✗ | ✓ | ✓ | ✓ |
| Filtration performance rate as per ISO 23328-1 (salt test) | 99.98% | 99.98% | 99.953 | 99.992 | 99.953 | 99.94% | 99.75% | 99.75% |
| Country of Manufacture | Lithuania | Lithuania | UK | UK | UK | Malaysia | Malaysia | Malaysia |



| Mechanical Non-ported | | | | |
|---|---|---|---|---|
| Supplier | Flexicare Medical | PALL MEDICAL | PALL MEDICAL | Teleflex |
| MPC | 038-41-370 | BB100E | BB50TE | 28012 |
| NPC | FTC2005 | FTC603 | FTC150 | FDC1228 |
| Description | Breathing Filter Adult Mechanical Non-Ported Straight | Breathing Filter Adult Mechanical Non-Ported Straight | Breathing Filter Adult Mechanical Non-Ported Straight | HMEF Mechanical Adult Non-Ported Straight |
| Picture |  |  |  | |
| UOI | 50 | 50 | 50 | 20 |
| Stocked | Blue Diamond | Blue Diamond/ Stocked | Stocked | Stocked |
| Recommended max duration of use | 24 Hours | 48 Hours | 24 Hours | 24 Hours |
| Internal volume | 47 ml | 85 ml | 90 ml | 80 ml |
| Hydrophobic filter | ✓ | ✓ | ✓ | ✓ |
| Tidal volumes (VT) | >141ml | > 150 ml | Not Available | 300ml - 1200ml |
| Product is latex free | ✓ | ✓ | ✓ | ✓ |
| Sterile | ✗ | ✗ | ✗ | ✗ |
| Breathing system port 22F/15M | ✓ | 22F (only) | 22F (only) | 22F (only) |
| Patient connection port 22M/15F | ✓ | ✓ | 15M (only) | ✓ |
| Flow resistance product & pressure at 30L Pre / Post Conditioning (cmH2O) | 1.7 / Not available | 1.0 / 1.0 | 1.0 / 1.0 | 1.03 / 1.03 |
| Flow resistance product & pressure at 60L Pre / Post Conditioning (cmH2O) | 3.5 / Not available | 2.5 / 2.5 | 2.0 / 2.0 | 2.31 / 2.30 |
| HEPA filtration | ✓ | ✗ | ✗ | ✓ |
| Filtration performance rate as per ISO 23328-1 (salt test) | 99.95% | 99.992 | 99.984 | 99.94% |
| Country of Manufacture | China | UK | UK | Malaysia |

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”.^{1,2}

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).^{2,9}

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.¹⁰

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.⁹

HEPA Filter

HEPA filtration works by mechanical means and stands for High Efficiency Particulate Air. The HEPA filter standard is to remove at least 99.97% of particles from the air down to at least 0.3 microns in size¹²

Filtration

Breathing filters are intended to reduce transmission of particulates to prevent cross infection to and from the patient during anaesthesia or other types of ventilation, however filtration performance varies.

Comparing the results from various tests is difficult because of the use of different test methods and organisms. In particular, the filtration efficiency of filter media varies with the size of the particles in the challenge to the filter.

The filtration performance rate in the matrix uses the same, national and comparable ISO 23328-1 salt test method to assess filtration performance. The salt test assists end users to make an objective comparison between filters supplied by different manufacturers, by challenging the filters with sodium chloride particles in the most penetrating particle size range.^{3,4}

- Microbial challenges provide differing results depending on their particle size.

For a similar comparison Centers for Disease Control (CDC) (2020) recommend that a respiratory protective device has a filtration efficiency level of particle penetration (NaCL – Salt) of at least 95% as an effective barrier

- FFP2 masks have a minimum of 94% filtration percentage
- FFP3 masks have a minimum filtration percentage of 99%



It could be considered breathing filter filtration rates are comparable to required respiratory protective device (FFP) filtration rates.⁶

The CDC requirement that the filtration efficiency level of particle penetration (NaCl – Salt)

- Must be at least 95%
 - This implies bacterial filtration efficiency of at least 99.9%¹¹
- All breathing filters on NHSSC framework must have a minimum efficiency of 99.9%

In line with CDC requirements on filtration efficiency level the salt test must be greater than 95%.⁷

Research suggests mechanical filters (Pleated hydrophobic) typically allow significantly fewer particles to pass through than electrostatic filters.¹¹

Filter Components

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.⁸

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 details of 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.⁸



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 23328-2:2009)
4. BS EN ISO 23328-1:2008. Breathing system filters for anaesthetic and respiratory use Part 1: Salt test method to assess filtration performance (ISO 23328-1:2008)
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