BREATHING FILTERS

Medtronic
Further, Together

CONTENT

FILTRATION AND CROSS CONTAMINATION

FILTRATION AND CROSS CONTAMINATION

Filtration plays a major role in reducing the risk of cross infections and protecting the patient's airway during ventilation in anaesthesia and intensive care.

In mechanically ventilated patients, the upper airways are bypassed by an artificial airway thus, unlike during normal breathing, inspired gases are not filtered before reaching the lungs.

As anaesthetic circuits may be used for more than one patient, any microorganisms which could be expelled by one patient in the form of aerosolized droplets or as sputum, should be prevented from entering the breathing system[1].

It is therefore recommended to place highly effective breathing filters at the y-piece, or at the distal expiratory limb of the circuit to provide barrier against bacteria, viruses and patient secretions, preventing cross contamination among patients, medical staff and equipment. Breathing filters should also be used as protection mechanisms against contamination of hot water bath humidification systems.

Medtronic DAR™ breathing filters may feature a mechanical (also called pleated hydrophobic) or an electrostatic filtering membrane. Both filter media have been shown to provide effective protection against cross contamination [2,3].

Protocols for bacterial and viral filtration tests might differ and affect filtration efficiency results.

For a comparison of filters' efficiency, refer to Nacl efficiency data, as per ISO 23328-1.

PLEATED MECHANICAL FILTERS

How do they work?

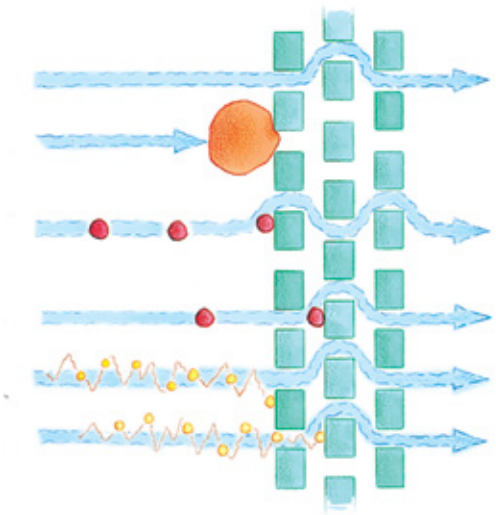
Sealed inside the external housing of mechanical filters is a glass microfibre membrane. The physical specifications of this material make it an ideal filter medium. Microfibres are arranged randomly in a dense weave so that pore size, though irregular, is on average very small and particle capture is highly effective. This small pore size means that an extended filtration surface is needed to lower inspiratory and expiratory resistance to flow and work of breathing. To minimise resistance, a large filtration surface is used. The membrane is pleated to allow use of low-volume housing.

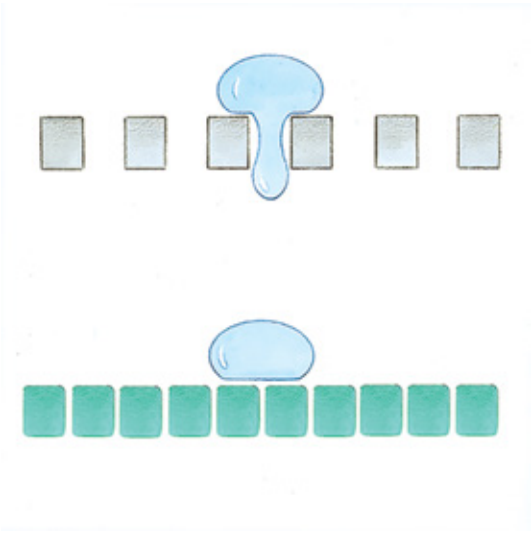
Advantages of hydrophobicity

Gas borne transmission of microbes is one route of cross infection; a second is the risk of cross contamination coming from the liquid borne route. Thanks to their hydrophobic properties, Medtronic DAR™ pleated mechanical filters have been shown to be particularly effective in preventing the passage of liquids, meaning they will reduce the risk of patient secretions or other liquids contaminating the system.

Several studies[2,4,5] have shown that liquid in the form of sputum and condensation may be forced through a breathing system filter if sufficient pressure is applied and that liquid penetration occurs at significantly lower pressures for electrostatic compared to mechanical pleated filters.

These results suggest the usage of pleated mechanical filter to be particularly beneficial if the anaesthetic or the intensive care equipment is being used on a known or suspected infected patient,[5] or when a circle anaesthesia breathing system is employed due to the inherent presence of condensate.





FILTRATION AND CROSS CONTAMINATION

QUALITY AT 360 DEGREES

With the aim of improving patient outcomes and ensuring comfort and safety, extensive testing has been performed on Medtronic DAR™ range of mechanical and electrostatic filters and filter-HMEs.

All products are individually tested during the manufacturing stage to ensure their integrity. Efficiency tests using aerosols of monodispersed bacteria and viruses, as well as sodium chloride challenge testing, have also been conducted at internationally recognised centres.

Relevant standards

All filters have been tested in compliance with the current revision of the following standards:

EN ISO 23328-1 breathing system filters for anaesthetic and respiratory use – Part 1: Salt test method to assess filtration performance.

EN ISO 23328-2 breathing system filters for anaesthetic and respiratory use - Part 2: Non-filtration aspects.

EN ISO 9360-1 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.

EN ISO 9360-2 anaesthetic and respiratory equipment - Heat and Moisture Exchangers (HMEs) for humidifying respired gases in humans - Part 2: HMEs for use with tracheostomised patients having minimum tidal volumes of 250 ml.

ELECTROSTATIC FILTERS

Electrostatic filters offer high levels of microbial filtration, coupled with a low resistance to flow.

The filter membrane is made of a hydrophobic flat non-woven polypropylene material, which has a permanent electrical charge induced during manufacture.

Electrostatic filtration can be likened to magnetism, with opposites attracting each other.

Each fibre has an electrostatic positive charge (+) on one side and a negative one (-) on the other. By effect of their superficial electrostatic charge, bacteria and viruses are attracted to oppositely charged sites on the fibres and trapped within the filter membrane.

Small and light rounded, Medtronic DAR™ electrostatic filters are easy to handle and minimise pressure and torque on patient.

ISO 594-1 conical fittings with a 6% (Luer) taper for syringes, needles and certain other medical equipment - Part 1: General requirements.

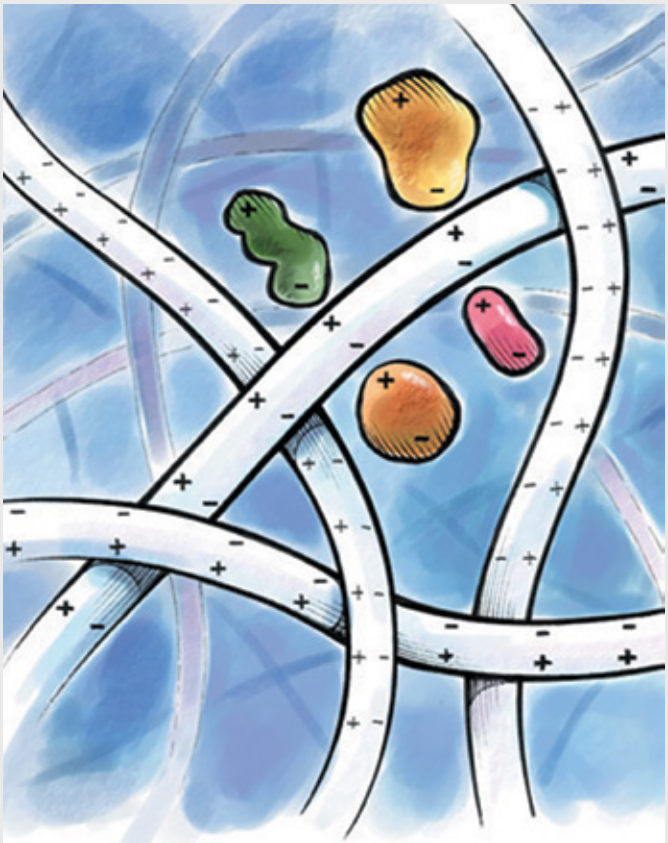
ISO 594-2 conical fittings with a 6% (Luer) taper for syringes, needles and certain other medical equipment - Part 2: Lock fittings.

All products are CE marked according to the European Council Directive MDD 93/42/EEC and are manufactured in a facility whose quality system complies with the international quality management and quality assurance standards ISO 13485 and MDD 93/42/EEC.

The manufacturing facilities are regularly inspected by TÜV product service, acting as MDD Notified Body #0123 and quality system certification Body, and USA/FDA for compliance with US GMP.

Sterility

Medtronic DAR™ filters, HMEs and FHMEs are available sterile and are sterilised by ethylene oxide exposure. The whole cycle is validated according to ISO 11135-1 standard. Sterility is tested and assured according to current revision of the European and US Pharmacopoeia and EN 556-1.



FILTRATION AND CROSS CONTAMINATION

MECHANICAL FILTERS

The mechanical filter range consists of a complete line of products for different applications in anaesthesia and intensive care. In addition to protecting patient and staff from cross infection, the systematic use of breathing filters may result in cost saving by protecting ventilation equipment and extending the life of breathing systems[6].

Mechanical Filter Large

An excellent filter for ventilator protection in both intensive care and anaesthesia with recommended usage at the inspiratory and expiratory outlet of the ventilator. The mechanical filter, large has been tested against hepatitis C Virus[7], mycobacterium tuberculosis[8] and allergenic natural latex proteins.[9]

Mechanical Filter Compact

Lightweight and compact, it can be used for patient or ventilator protection in both anaesthesia and intensive care. The mechanical filter, compact has been tested against hepatitis C virus[10] and HIV-1.[11]

Mechanical Filter Small

Indicated for short-term anaesthesia, it is at the same time highly efficient and compact. Its reduced internal volume makes it an excellent choice for most paediatric and adult use with positioning at the y-piece. Mechanical filter, small has been successfully validated against pathogenic microorganisms such as HCV[12], HIV-1[13] and mycobacterium tuberculosis[14] and for filtration of allergenic natural latex proteins[9] and prion proteins.[15] The mechanical filter range has predominantly filtering properties. For mechanical ventilation, the selection of devices with adequate humidification performance is recommended. "Clinical results indicate that devices that deliver gases with an AH >30 mg H_2O/l have low risk of endotracheal tube occlusions, even during prolonged use."[16]

	Mechanical Filter LARGE	Mechanical Filter COMPACT	Mechanical Filter SMALL
			
Tidal volume range	300 - 1500 ml	200 - 1500 ml	150 - 1200 ml
NaCl filtration efficiency[17]	≥99.978%*	≥99.747%	≥99.512%*
Bacterial filtration efficiency	≥99.9999%[18]	≥99.9999%[19]	≥99.9999%[18]
Viral filtration efficiency	≥99.999%[20]	≥99.9999%[21]	≥99.997%[20]
Resistance to flow*	–	–	0.5 cm H_2O at 15 l/min
	0.8 cm H_2O at 30 l/min	0.8 cm H_2O at 30 l/min	1.2 cm H_2O at 30 l/min
	2 cm H_2O at 60 l/min	1.9 cm H_2O at 60 l/min	2.7 cm H_2O at 60 l/min
	3.6 cm H_2O at 90 l/min	3.2 cm H_2O at 90 l/min	4.5 cm H_2O at 90 l/min
Moisture loss*	13 mg H_2O/l at Vt 500 ml	15 mg H_2O/l at Vt 500 ml	17 mg H_2O/l at Vt 500 ml
Moisture output[22]	23 mg H_2O/l at Vt 500 ml	21 mg H_2O/l at Vt 500 ml	16 mg H_2O/l at Vt 500 ml
Internal volume*	92 ml	66 ml	42 ml
Weight*	47 g	39 g	24 g

The above data are average values.

*Internal testing, Mirandola (various 2006-2008).

MECHANICAL FILTER RANGE CONFIGURATIONS

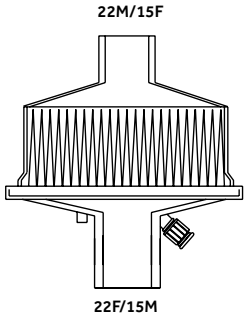
Available also with tethered CO_2 port caps for increased safety. Caps are secured to luer lock port connectors to prevent them from being misplaced during use.

All products are latex free.

Individually packed, sterile, in boxes of 25.

This is a selection of the Medtronic DAR™ mechanical filter range.

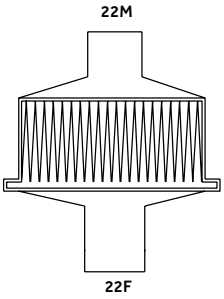
Mechanical Filter LARGE



351/5410

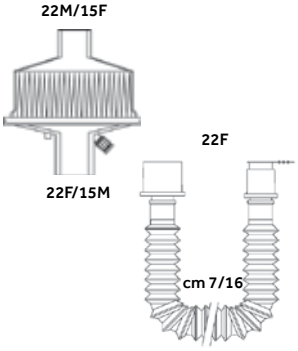
351/5410TC
with tethered cap

Mechanical Filter LARGE



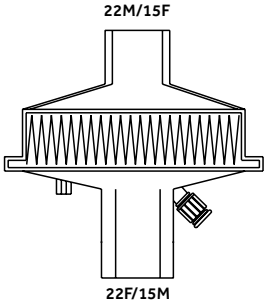
351/5856
without CO2 port

Mechanical Filter LARGE



351/5835
with extendible catheter mount

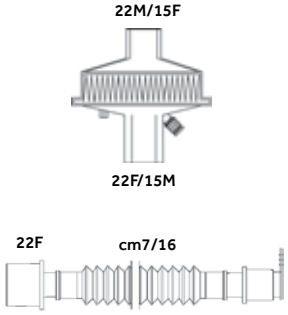
Mechanical Filter COMPACT



351/5878

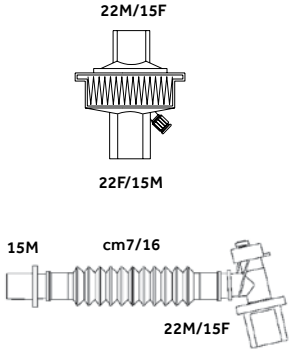
351/5878TC
with tethered cap

Mechanical Filter COMPACT



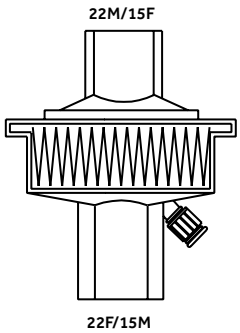
351/5848
with extendible catheter mount

Mechanical Filter SMALL



351/5994
with extendible catheter

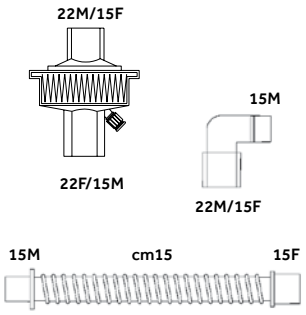
Mechanical Filter SMALL



351/5979

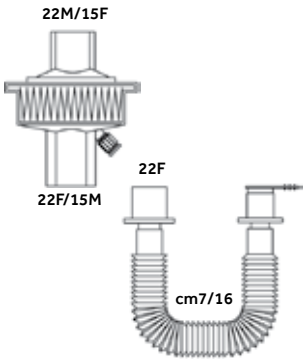
351/5979TC
with tethered cap

Mechanical Filter SMALL



351/5987
with elbow and PVC catheter mount

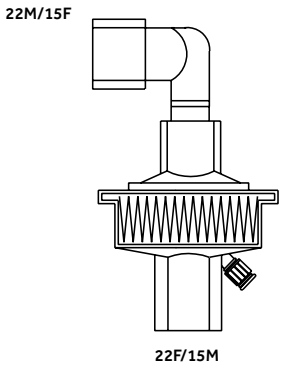
Mechanical Filter SMALL



351/5980
with extendible catheter mount

351/5980TC
with tethered cap

Mechanical Filter SMALL



351/5984
with elbow

FILTRATION AND CROSS CONTAMINATION

ELECTROSTATIC FILTERS

When a simple and efficient filter is needed, the electrostatic filter range is a cost effective solution. Large, small and paediatric/neonatal filters differ only in size and their round shape makes handling easier and their light weight minimises pressure and torque on patient airway when placed at the y-Piece. They are an excellent choice for short term anaesthesia when an HME is not required.

Electrostatic Filter Large

High filtration efficiency coupled with low resistance to flow make it acceptable for ventilator protection in both intensive care and anaesthesia.

Electrostatic Filter Small

Lighweight and compact in volume, it is suitable for use on both adult and paediatric patients as effective protection in short term anaesthesia. Electrostatic filter, small, angled port with an integral 90° elbow is also available. Electrostatic filter, small has been tested against hepatitis C virus.[23]

Electrostatic Filter Small, Paediatric-Neonatal

Specifically designed for short anaesthesia, it is an effective solution for patients with a tidal volume between 30-100 ml, to prevent the risks of cross contamination and allow the use of a simple breathing system.

The electrostatic filter range has predominantly filtering properties. For mechanical ventilation, the selection of devices with adequate humidification performance is recommended. "Clinical results indicate that devices that deliver gases with an AH >30 mg H_2O/l have low risk of endotracheal tube occlusions, even during prolonged use."[16]

	Electrostatic Filter Large	**Electrostatic Filter Small**	**Electrostatic Filter Small, Angled port**	**Electrostatic Filter Small Paediatric-Neonatal**
				
Tidal volume range	300 - 1500 ml	150 - 1200 ml	150 - 1200 ml	30 - 100 ml
NaCl filtration efficiency[17]	≥99.592%*	≥98.096	≥98.096*	≥94.409%*
Bacterial filtration efficiency	≥99.9999%[18]	≥99.9999%[19]	≥99.9999%[18]	≥99.999%[25]
Viral filtration efficiency	≥99.9999%[20]	≥99.9999%[21]	≥99.999%[20]	≥99.99%[27]
Resistance to flow*	–	–	–	0.3 cm H_2O at 2.5 l/min
	–	–	–	0.6 cm H_2O at 5 l/min
	0,6 cm H_2O at 60 l/min	0.8 cm H_2O at 30 l/min	0.9 cm H_2O at 30 l/min	0.9 cm H_2O at 7.5 l/min
	1.5 cm H_2O at 60 l/min	2.1 cm H_2O at 60 l/min	2.3 cm H_2O at 60 l/min	1.3 cm H_2O at 10 l/min
	2.6 cm H_2O at 90 l/min	3.7 cm H_2O at 90 l/min	4.3 cm H_2O at 90 l/min	2.0 cm H_2O at 15 l/min
Moisture loss*	17 mg H_2O/l at Vt 500 ml	18 mg H_2O/l at Vt 500 ml	18 mg H_2O/l at Vt 500 ml	
Moisture output[22]	16 mg H2O/l at Vt 500 ml	9 mg H_2O/l at Vt 500 ml	9 mg H_2O/l at Vt 500 ml	
Internal volume*	99 ml	36 ml	44 ml	11 ml
Weight*	35 g	19 g	21 g	8 g

The above data are average values.

*Internal testing, Mirandola (various 2006- 2013).

ELECTROSTATIC FILTER RANGE CONFIGURATIONS

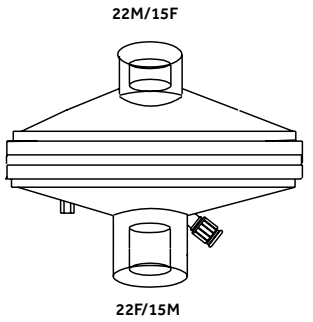
Available also with tethered CO_2 port caps for increased safety.

All products are latex free.

Individually packed, sterile, in boxes of 25.

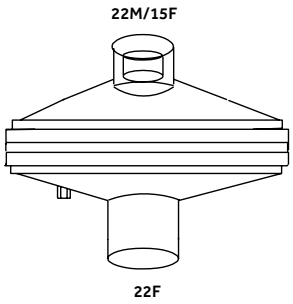
This is a selection of the Medtronic DAR™ electrostatic filter range.

Electrostatic Filter LARGE



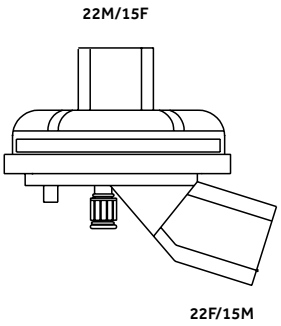
350/5422

Electrostatic Filter LARGE



350/5865
without CO2 port

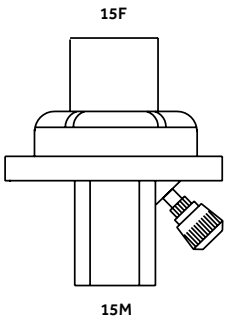
Electrostatic Filter SMALL, ANGLED PORT



350S19006

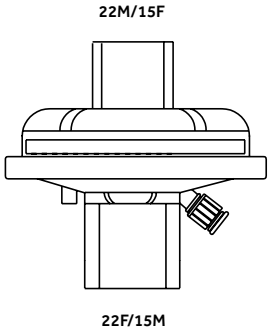
350S19006TC
with tethered cap

Electrostatic Filter SMALL PAEDIATRIC-NEONATAL



350/19003

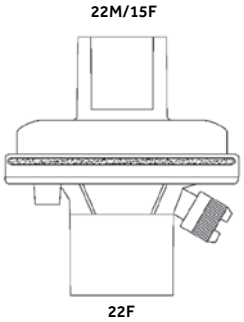
Electrostatic Filter SMALL



350/5879

350/5879TC
with tethered cap

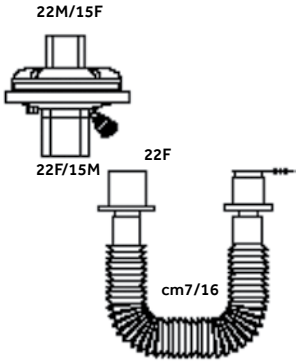
Electrostatic Filter SMALL



350/5845

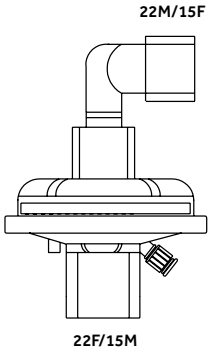
350/5845TC
with tethered cap

Electrostatic Filter SMALL



350/5882
with extendible catheter mount
with cap

Electrostatic Filter SMALL



350/5420
with removable 90° elbow

350/5420TC
with extendible catheter

SPIROMETRY FILTER AND MONITORING LINE FILTERS

ELECTROSTATIC SPIROMETRY FILTER MICROBIAL FILTER FOR PULMONARY FUNCTION TESTING

The electrostatic spirometry filter has been created and developed to protect both patients and equipment during lung function testing.

The electrostatic spirometry filter may reduce the risk of cross contamination by providing protection against micro-organisms inspired and expired by patients during testing[28].

In compliance with the guidelines released jointly by the European Respiratory Society and the American Thoracic Society[29], electrostatic spirometry filter resistance is lower than the maximum limit of 1.5 cm H_2O /l/sec in a flow range of 0-14 l/sec and does not impair test results.

Its anatomical oval shape ensures maximum patient comfort and subsequent reliable test results.

A series of accessories make the electrostatic spirometry filter compatible with a range of testing equipment and suitable for different spirometry techniques.

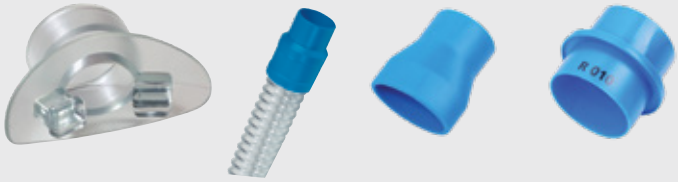
Electrostatic Spirometry Filter

REF	500P30022
Type of filtration	Electrostatic
Bacterial filtration efficiency[30]	≥99.9%
Viral filtration efficiency[31]	≥99.2%
Resistance to flow*	0.6 cm H_2O/l/sec at 5 l/sec
	0.9 cm H_2O/l/sec at 8 l/sec
	1.1 cm H_2O/l/sec at 12 l/sec
	1.3 cm H_2O/l/sec at 14 l/sec
Internal volume*	56 ml
Weight*	14 g

*Internal testing, Mirandola (2005).
Individually packed in boxes of 25.
The above data are average values.

SPIROMETRY FILTER AND MONITORING LINE FILTERS

ELECTROSTATIC SPIROMETRY FILTER ACCESSORIES



REF		Packaging
500P30021	Electrostatic Spirometry Filter Mouthpiece, Oval Shaped	25 ea/box
500P30580	Calibration Syringe Adapter, Reusable 28÷30F	1 ea/box

Adapters for lung function testing equipment

	Electrostatic Spirometry Filter Connection	Device Connection	
R001	33F	22F	10 ea/box
R002	33F	25F	10 ea/box
R004	33F	27F	10 ea/box
R005	33F	27.5F	10 ea/box
R006	33F	28F	10 ea/box
R007	33F	28.5F	10 ea/box
R009	33F	29F/33M angled	10 ea/box
R010	33F	30F	10 ea/box
R011	33F	30.5F	10 ea/box
R012	33F	31F	10 ea/box
R013	33F	32F	10 ea/box
R014	33F	33F	10 ea/box
R015	33F	34F	10 ea/box
R016	33F	35F	10 ea/box
R017	33F	40F	10 ea/box
R018	33F	44F	10 ea/box
R019	33F	45F	10 ea/box
R020	33F	22M	10 ea/box
R022	33F	27M	10 ea/box
R023	33F	28M	10 ea/box
R024	33F	29.5M	10 ea/box
R025	33F	30M	10 ea/box
R026	33F	30.5M	10 ea/box
R027	33F	31M	10 ea/box
R029	33F	33.5M	10 ea/box

Electrostatic spirometry filter and its accessories are supplied clean.
All products are latex free.

MONITORING LINE FILTER

The monitoring line filter has been designed to reduce the risk of cross contamination of patients and equipment. It functions as an antimicrobial bi-directional Filter for use on gas lines such as:

- Pressure monitoring lines
- Sensors/flow transducer connecting lines
- Sampling lines for gas analysers (oxygen and halogenate gases)
- Nebuliser drive lines

All products are latex free.

Monitoring Line Filter

Type of filtration	Electrostatic
Bacterial filtration efficiency[25]	≥99.999%
Viral filtration efficiency[27]	≥99.99%
Resistance to flow*	0.1 cm H_2O at 1 l/min
	0.3 cm H_2O at 2 l/min
	0.6 cm H_2O at 3 l/min
	1.4 cm H_2O at 5 l/min
	4.4 cm H_2O at 10 l/min
	9.2 cm H_2O at 15 l/min
Internal volume*	7.5 ml
Weight*	10 g
Connections*	7 mm O.D.

*Internal testing, Mirandola (2009)
The above data are average values.

REF		Packaging
350S5807	Monitoring Line Filter - single packed, sterile	25 ea/box
350P5807	Monitoring Line Filter - single packed, clean	25 ea/box
350/5957	Monitoring Line Filter - multiple pack, clean	50 ea/box
291/7492	Pressure Monitoring Line with Filter, length 15 cm, 3.7x6.1 mm diam.	25 ea/box
291/7499	Pressure Monitoring Line with Filter, length 14 cm, 3.7x6.1 mm diam. with male luer connector	25 ea/box

Additional Monitoring Line Filter sets available.

HUMIDIFICATION
THE NEED FOR HEAT AND MOISTURE

Intubation bypasses the upper airway, preventing it from heating and humidifying inspired air. Within ten minutes, mucous viscosity and heat loss increase. More serious complications may occur if the patient is intubated for longer.

Passive Heat and Moisture Exchangers (HMEs) simulate the natural humidification of the upper airway by capturing the patient's own heat and moisture from expired air. As the patient breathes in, the heat and moisture in the HME warms and humidifies the air.

Thanks to their capability to maintain physiological air conditioning even in long term ventilated patients[32], HMEs are recommended for use during anaesthesia, in intensive care and in post-tracheostomy care.

When combined with a mechanical or electrostatic filtering medium, HMEs help protect the patient and the equipment from microbial contamination, providing a valid option to avoid the costs of frequent decontamination of the breathing system and of the anaesthesia or intensive care ventilator[1, 2, 3, 6].

Available clinical evidence suggests that no recommendation can be made for the preferential use of either HMEs or heated humidifiers as a preventive measure against Ventilator-Associated Pneumonia.

Several studies[33, 34, 35] indicate that, by preventing condensation in the breathing tubing, heat and moisture exchangers reduce circuit management, thereby decreasing staff work load and the potential risk of cross contamination with substantial cost savings.

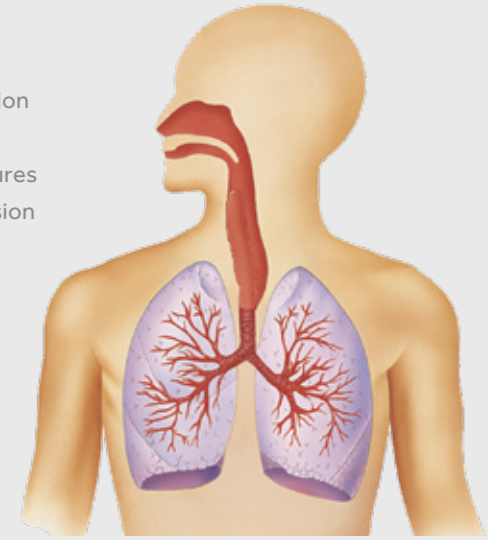
The authors of these studies [33, 34, 35], therefore, suggest that HMEs should represent a preferred solution in a global policy against nosocomial infections for those patients who have no contraindications.

Potential Complications of OVER-HUMIDIFICATION

- Increased risk of nosocomial infection
- Increased mucousal secretions
- Increased need for suction procedures
- Tracheal tube narrowing and occlusion
- Condensation of water may block airway causing atelectasis

Typical characteristics of dry unheated medical gas

Temp. 20°C
A.H. 1mg H_2O/l



Potential Complications of UNDER-HUMIDIFICATION

- Tracheal tube restrictions and occlusions
- Impairment of mucous and ciliary functions
- Atelectasis
- Increased incidence of postoperative pulmonary complications
- Alteration of pulmonary mechanics causing hypoxemia

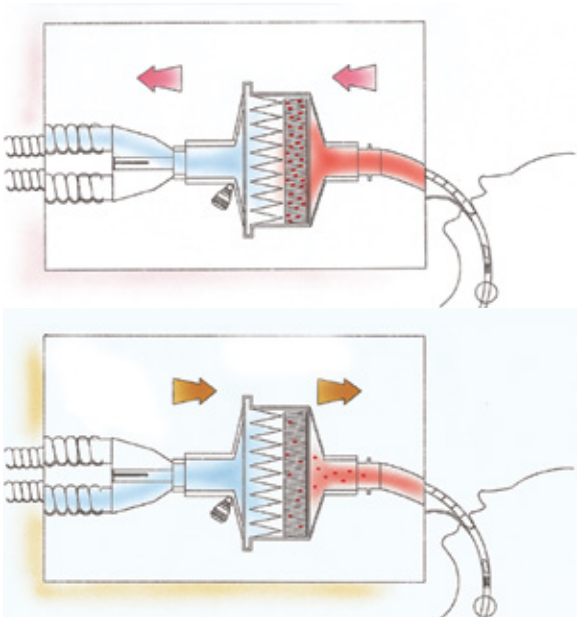
Temperature and moisture conditions at Isothermic Saturation Zone (ISZ)

Temp. 37°C
A.H. 44mg H2O/l

HEAT AND MOISTURE EXCHANGER FUNCTIONING

During expiration the heat and moisture in the patient's exhaled breath are trapped by the cellulose HME element. The filter membrane prevents contamination of the external environment and equipment.

On the subsequent inspiration, the trapped heat and moisture are released to the patient. The Filter membrane prevents any microorganisms the patient and causing cross infection.



DAR™ HMES AND FILTER HMES

Coviden DAR was the first manufacturer to develop a high performance filter HME (FHME) by coupling a moisture output element with an electrostatic filter membrane, hygrobac.

From this first and innovative product, Medtronic has developed a series of products that are state-of-the-art in the field of heat and moisture exchange technology. An important aspect of the Medtronic DAR™ product line is the diversification of the HME and FHME models to suit the end-user requirements.

All products have been tailored to meet the specific needs of anaesthesia, intensive care and home care.

HUMIDIFICATION
THE NEED FOR HEAT AND MOISTURE

FILTER-HMES RANGE

Medtronic DAR™ filter-HMEs are available with pleated mechanical or electrostatic filtration materials so you can choose the product incorporating the filtration medium which best suits your clinical needs. Whichever DAR product you choose, you are assured of first class levels of humidification and protection from cross contamination for your staff and your patients.

MECHANICAL FILTER-HMES

Adult-Paediatric mechanical filter HME, LARGE

Ideal for use in ICU, it combines effective humidification with the high levels of hydrophobicity and filtration which only the pleated mechanical filter material can provide.
The adult-paediatric mechanical filter HME, large has been tested against hepatitis C virus36, HIV-1[37] and mycobacterium tuberculosis[38].

Adult-Paediatric Mechanical Filter HME, LARGE

Type of filtration	Mechanical
Tidal volume range	300 - 1500 ml
NaCl filtration efficiency	≥99.764%[17]*
Bacterial filtration efficiency	≥99.9999%[41]
Viral filtration efficiency	≥99.9999%[43]
Resistance to flow*	
	1.1 cm H_2O at 30 l/min
	2.5 cm H_2O at 60 l/min*
	4.2 cm H_2O at 90 l/min
Moisture loss	5 mg H_2O/l at Vt 500 ml[57]
Moisture output	34 mg H_2O/l at Vt 500 ml[22]
Internal volume*	96 ml
Weight*	49 g

*Internal testing, Mirandola (various 2006-2008).
The above data are average values.

FILTER-HMES RANGE

ELECTROSTATIC FILTER-HMES

Adult-Paediatric Electrostatic Filter HME, LARGE

Effective electrostatic filtration, high moisture output and low resistance to air flow make it suitable for most ventilation techniques on adult patients. The adult-paediatric electrostatic filter HME large has been tested against hepatitis C virus[46].

Adult-Paediatric Electrostatic Filter HME, SMALL

Designed for use in intensive care and routine anaesthesia, adult-paediatric electrostatic filter HME small is today the filter/HME of choice for all applications, both on adult and paediatric patients, due to its compact size with no compromise on filtration efficiency and moisture output. It is also available in an angled version called adult-paediatric electrostatic filter HME small, angled port.
The adult-paediatric electrostatic filter HME small has been tested against hepatitis C virus[47], HIV-1[48] and mycobacterium tuberculosis[49].

Infant-Paediatric Electrostatic Filter HME, Small/ Paediatric-Neonatal Electrostatic Filter HME, SMALL

Optimal size for paediatric and infant patients, they are a simple and effective solution on patients undergoing short term intubation.

	Adult-Paediatric Electrostatic Filter HME, LARGE	Adult-Paediatric Electrostatic Filter HME, SMALL	Adult-Paediatric Electrostatic Filter HME, SMALL, Angled Port	Infant-Paediatric Electrostatic Filter HME, SMALL	Paediatric-Neonatal Electrostatic Filter HME, SMALL
					
Type of filtration	Electrostatic	Electrostatic	Electrostatic	Electrostatic	Electrostatic
Tidal volume range	300 - 1500 ml	150 - 1200 ml	150 - 1200 ml	75 - 300 ml	30 - 100 ml
NaCl filtration efficiency	≥99.623%*	≥98.352%[58]	≥98.352%[58]	≥96.263%[17]	≥94.186%[17]
Bacterial filtration efficiency	≥99.9999%[50]	≥99.9998%[18]	≥99.9998%[18]	≥99.999%[51]	≥99.999%[52]
Viral filtration efficiency	≥99.998%[53]	> 99.999%[20]	>99.999%[20]	≥99.99%[54]	≥99.99%[55]
Resistance to flow*					0.3 cm H_2O at 2.5 l/min
	1 cm H_2O at 30 l/min	1.2 cm H_2O at 30 l/min	1.2 cm H_2O at 30 l/min	1.4 cm H_2O at 15 l/min	0.6 cm H_2O at 5 l/min
	2.1 cm H_2O at 60 l/min	2.7 cm H_2O at 60 l/min	2.9 cm H_2O at 60 l/min	3 cm H_2O at 30 l/min	1 cm H_2O at 7.5 l/min
	3.7 cm H_2O at 90 l/min	4.8 cm H_2O at 90 l/min	5.2 cm H_2O at 90 l/min	4.7 cm H_2O at 45 l/min	1.5 cm H_2O at 10 l/min
					2.5 cm H_2O at 15 l/min
Moisture loss	6 mg H_2O/l at Vt 500 ml*	6 mg H_2O/l at Vt 500 ml[56]	6 mg H_2O/l at Vt 500 ml*	6 mg H_2O/l at Vt 75 ml*	Not applicable
				8 mg H_2O/l at Vt 250 ml*	Not applicable
Moisture output[22]	33 mg H_2O/l at Vt 500 ml	33 mg H_2O/l at Vt 500 ml	33 mg H_2O/l at Vt 500 ml	31 mg H_2O/l at Vt 250 ml	28 mg H_2O/l at Vt 50 ml
Internal volume*	93 ml	51 ml	61 ml	29 ml	10 ml
Weight*	48 g	28 g	29 g	21 g	9 g

*Internal testing, Mirandola (various 2000- 2013).
The above data are average values.

HUMIDIFICATION
THE NEED FOR HEAT AND MOISTURE

FILTER-HMES
RANGE CONFIGURATIONS

MECHANICAL AND ELECTROSTATIC FILTER-HMES

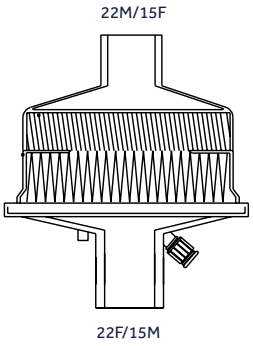
Available also with tethered CO_2 port caps for increased safety.

All products are latex free.

Individually packed, sterile, in boxes of 25.

This is a selection of the Medtronic DAR™ filter-HME range.

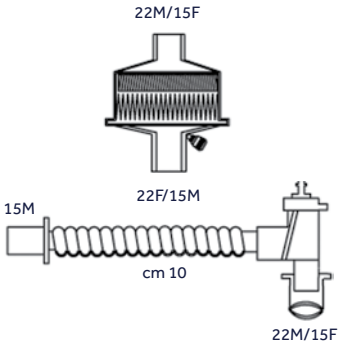
Adult-Paediatric Mechanical Filter HME, LARGE



354/5876

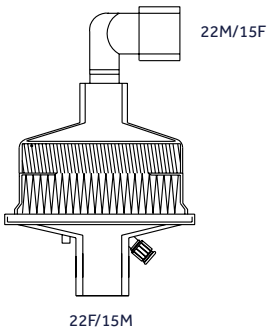
354/5876TC
with tethered cap

Adult-Paediatric Mechanical Filter HME, LARGE



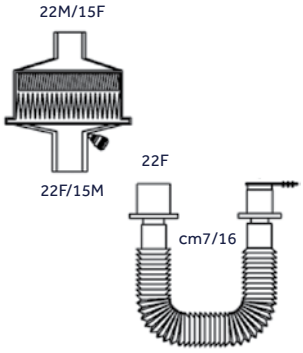
354/5833
with double swivel PVC catheter mount

Adult-Paediatric Mechanical Filter HME, LARGE



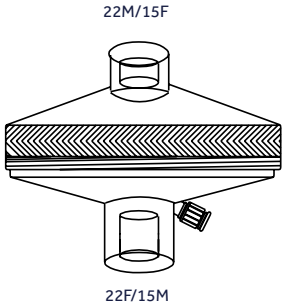
354/5900
with elbow

Adult-Paediatric Mechanical Filter HME, LARGE



354/5902
with extendible catheter mount

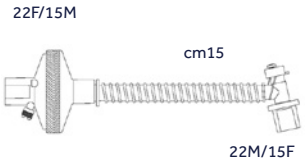
Adult-Paediatric Electrostatic Filter HME, LARGE



352/5805

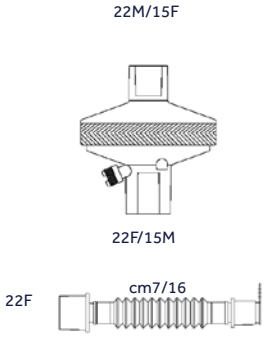
352/5805TC
with tethered cap

Adult-Paediatric Electrostatic Filter HME, LARGE



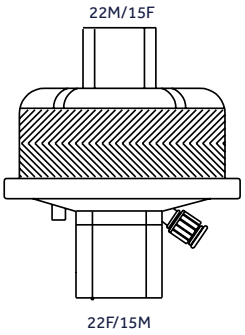
352/5811
with PVC catheter mount

Adult-Paediatric Electrostatic Filter HME, LARGE



352/5836
with extendible catheter mount

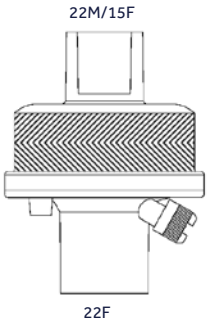
Adult-Paediatric Electrostatic Filter HME, SMALL



352/5877

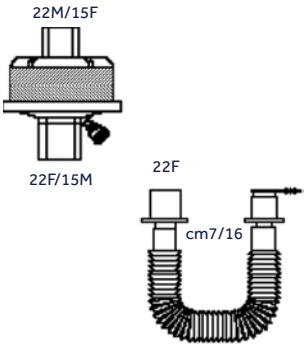
352/5877TC
with tethered cap

Adult-Paediatric Electrostatic Filter HME, SMALL



352/5844

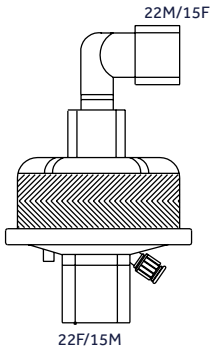
Adult-Paediatric Electrostatic Filter HME, SMALL



352/5855
with extendible catheter mount

352S5855BR
for Brazil only

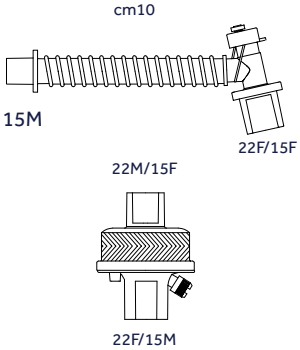
Adult-Paediatric Electrostatic Filter HME, SMALL



352/5867
with removable 90° elbow

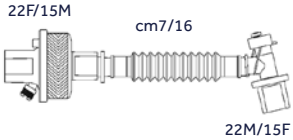
352/5867TC
with tethered cap

Adult-Paediatric Electrostatic Filter HME, SMALL



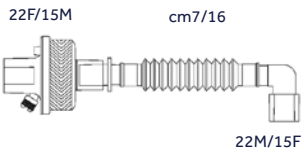
352/5881
with PVC catheter mount

Adult-Paediatric Electrostatic Filter HME, SMALL



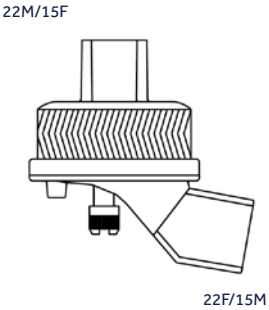
352/5893
with extendible catheter mount and double swivel elbow

Adult-Paediatric Electrostatic Filter HME, SMALL



352/5978

Adult-Paediatric Electrostatic Filter HME, SMALL, Angled Port



352/5996

352/5996TC
with tethered cap

HUMIDIFICATION
THE NEED FOR HEAT AND MOISTURE

FILTER-HMES
RANGE CONFIGURATIONS

ELECTROSTATIC FILTER-HMES

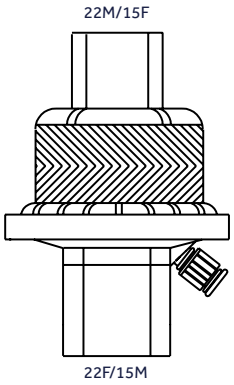
Available also with tethered CO_2 port caps for increased safety.

All products are latex free.

Individually packed, sterile, in boxes of 25.

This is a selection of the Medtronic DAR™ filter-HME range.

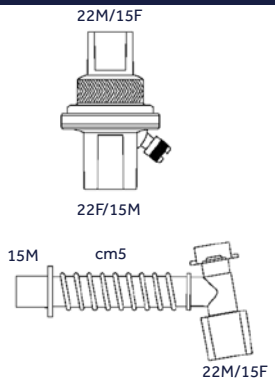
Infant-Paediatric Electrostatic Filter HME, SMALL



355/5430

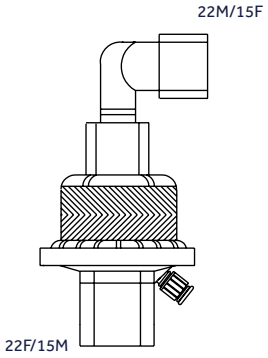
355/5430TC
with tethered cap

Infant-Paediatric Electrostatic Filter HME, SMALL



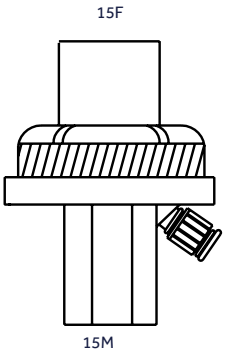
355/5814
with PVC catheter mount

Infant-Paediatric Electrostatic Filter HME, SMALL



355/5884
with elbow

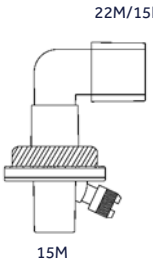
Paediatric-Neonatal Electrostatic Filter HME, SMALL



355/5427

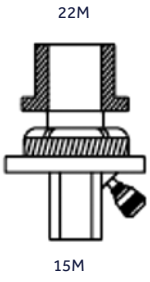
355/5427TC
with tethered cap

Paediatric-Neonatal Electrostatic Filter HME, SMALL



355/5860
with connector

Paediatric-Neonatal Electrostatic Filter HME, SMALL



355/5916
with 22M connector

HME-ONLY PRODUCTS FOR EXCELLENT AIRWAY HUMIDIFICATION

A RANGE OF EASY-TO-USE HMES FOR WHEN FILTRATION IS NOT REQUIRED.

HME for Tracheostomised Patients

Designed for spontaneously breathing tracheostomy patients. An integral oxygen port heats and humidifies supplemental oxygen.

Adult-Paediatric HME Small

Compact size and high HME performance make it ideal for use on adult and paediatric patients in anaesthesia, ICU and home care.

Adult-Paediatric Foam HME with Integrated Catheter Mount

Light weight and cost effective open cell foam HME for anaesthesia and ICU, it incorporates an extendible flexible catheter mount with variable internal volume.

	HME for Tracheostomised Patients	Adult-Paediatric HME Small	Adult-Paediatric Foam HME with Integrated Catheter Mount	HME for Tracheostomised Patients
				
Tidal volume range	>15 kg body weight	100 - 1000 ml	200 - 1000 ml	>15kg body weight
Resistance to flow	0.8 cm H_2O at 30 l/min	0.9 cm H_2O at 30 l/min	0.4 cm H_2O at 30 l/min	0.6cm H_2O at 30l/min
	1.8 cm H_2O at 60 l/min	2.2 cm H_2O at 60 l/min	1.2 cm H_2O at 60 l/min	1.1cm H_2O at 60 l/min
	3.2 cm H_2O at 90 l/min	4 cm H_2O at 90 l/min	2 cm H_2O at 90 l/min	1.7cm H_2O at 90l/min
Moisture loss	11 mg H_2O/l at Vt 500 ml	7 mg H_2O/l at Vt 500 ml	6 mg H_2O/l at Vt 500 ml	11mgH_2O/l at Vt 500ml
Moisture output	28.5 mg H_2O/l at Vt 500 ml	30 mg H_2O/l at Vt 500 ml	31.5 mg H_2O/l at Vt 500 ml	33mgH_2O/l at Vt 500ml
Internal volume	16 ml	29 ml	60 ml compressed/ 75 ml extended	13 ml
Weight	8.5 g	22 g	12 g	8g

Internal testing, Mirandola (various 2000-2008).
The above data are average values.

HUMIDIFICATION
THE NEED FOR HEAT AND MOISTURE

HME-ONLY CONFIGURATIONS

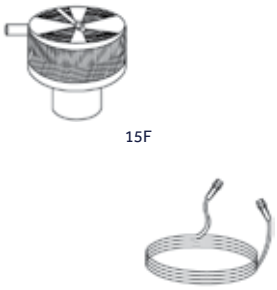
The adult-paediatric HME small is available with tethered CO_2 port cap for increased safety.

All products are latex free.

Individually packed, sterile, in boxes of 25.

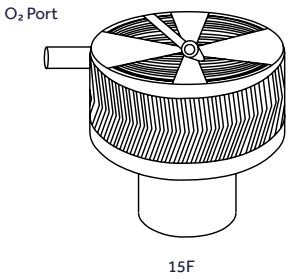
This is a selection of the Medtronic DAR™ HME range.

HME for Tracheostomised Patients



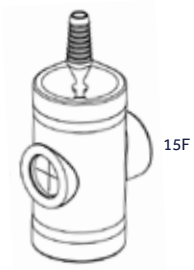
353/5921
with 200 cm oxygen tube

HME for Tracheostomised Patients



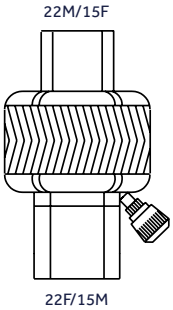
353/19004

HME for Tracheostomised Patients



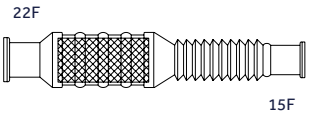
353S19046

Adult-Paediatric HME SMALL



353S19007

Adult-Paediatric Foam HME with Integrated Catheter Mount



353P5908

INDEX

INDEX - NUMERICAL

INDEX

Name of the Filter appearing in References	Actual name of the Filter
Barrierbaby	Electrostatic Filter Small Paediatric-Neonatal
Barrierbac	Electrostatic Filter Large
Barrierbac S	Electrostatic Filter Small
Barrierbac S-A	Electrostatic Filter Small Angled Port
Flexlife	Adult-Paediatric Foam HME with Integrated Catheter Mount
Hygrobaby	Paediatric-Neonatal Electrostatic Filter HME Small
Hygrobac	Adult-Paediatric Electrostatic Fiter HME Large
Hygrobac S	Adult-Paediatric Electrostatic Fiter HME Small
Hygrobac S-A	Adult-Paediatric Electrostatic Fiter HME Small, Angled Port
Hygroboy	Infant-Paediatric Electrostatic Fiter HME Small
Hygrolife II	Adult-Paediatric HME Small
Hygroster	Adult-Paediatric Mechanical Fiter HME Large
Spirobac	Electrostatic Spirometry Filter
Sterivent	Mechanical Filter Large
Sterivent Mini	Mechanical Filter Small
Sterivent S	Mechanical Filter Compact
Tracheolife II	HME for Tracheostomised Patients
Tracheolife III	HME for Tracheostomised Patients

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7 CAMR, Centre for Applied Microbiology and research, Porton Down , UK. Evaluation of BSF (Type DAR Sterivent) as a barrier to hepatitis C transmission within breathing systems. Aug. 1997.

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9 Barbara J et al, Laboratoire de Recherche en Immuno-Allergologie, Hôpital Tenon, Paris. Evaluation of latex particles retention performance of Sterivent Filters. 2002.

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