Breathing Filters and FHMEs

Product training
Introduction to DAR range
What does DAR mean

- **D** = Disposable
- **A** = Anaesthesia
- **R** = Rianimation (Intensive Care)

- From a small privately owned business in 1986 to a key component of COVIDIEN Respiratory and Monitoring Solutions

- DAR product solutions are used worldwide within and outside of the hospital to ensure ventilatory support and help prevent cross contamination
A complete range from the airway to the vent

Core Business

- Combined FHME’s Filters
- Artificial Noses (HME’s)
- Breathing Circuits
- Catheter Mounts
- Closed Suction Systems
- Guedel Airways Anaesthesia Masks
- Aerosol and O₂ Masks
Cross contamination
Breathing Filters prevent cross contamination
Possible risk of cross contamination
Possible risk of cross contamination

Can occur:

- between patients
- between patient and hospital staff
- between patient and environment (including equipment)
What is a nosocomial infection

- Develops in a hospitalised patient in whom the infection was not present or incubating at the time of hospital admission.

- Prevention:

  - disposable breathing circuits
  - use of filters - FHME’s
  - Closed suction
  - Hand hygiene
  - Aspiration of subglottic secretions (VAP)
  - Improved care of respiratory equipment
  - Advance in airway management: aspiration of subglottic secretions
Filtration
Why use filters?

- Filters prevent microbial cross-contamination in breathing systems.
- Intubation bypasses the upper airways which play a major role in the removal of contaminants in inspired gas.
- Filters are bi-directional, protect patient, equipment and staff.
In 1993 in Sydney (Australia), a case of Hepatitis C due to contamination of the anaesthetic equipment was registered.

Four patients were infected.
What should filters do?

- Breathing filters should remove particulate matters, bacteria and viruses from gas stream and prevent passage of contaminated body fluids from the patient.

- In order to provide adequate protection against microbiological challenge, as many organisms as possible should be removed by the filter.
Where to place a filter or FHME

- **Filter in respiratory limb**: to deliver filtered gases to patient.
- **2 Filters between patient–ventilator on machine side**: to protect from contamination on machine.
- **Filter at the “Y” between circuit-patient**: to protect from cross-contamination, to protect staff, to lengthen life of circuit.
Where to place a filter or FHME

- Filters
- Filters HME’s
- HME’s

Machine side

Patient side
Classification

1. Antibact. / viral filters
2. HME’s
3. Combined filters / HME’s
1. Antibacterial / viral filter

Device equipped with filtering membrane *only*

**Filtration:** yes  
**Humidification:** poor

**Ideal application:**  
Machine side, for protection of ventilator
2. Heat & Moisture Exchanger

Device equipped with a humidifying membrane *only*

**Filtration:** no  
**Humidification:** yes

**Ideal application:**  
Patient side only, for humidification of airways
3. Combined Filter / HME

Device equipped both with humidifying and filtering membrane

Filtration: yes
Humidification: yes

Ideal application:
Patient side only, for humidification and protection of patient’s airways
Filtering Media for Breathing Filters

- Mechanical filtering membrane
- Electrostatic filtering membrane
**Mechanical filtering membrane**

- Usually pleated to allow a large surface area of filter in a minimum volume
- Small pore size does not allow passage of liquid water
- **Efficiency usually > 99.999**

**Electrostatic filtering membrane**

- Thick and flat, electrostatic forces within filter are created during manufacturing by introducing a permanent electrical polarity into felt like material
- **Efficiency usually > 99.98**
Mechanical filters

- The mechanical filter membrane is a hydrophobic medium consisting of ceramic-covered microfibres.
- Thanks to the microporosity of the fibre web, the germs are trapped by means of a sort of screen filtration.
- The relatively high density of the medium requires a larger filtering surface to permit adequate flow resistance values during ventilation.
- To optimise the filtering surface into a reduced filtration volume, the mechanical membrane is generally folded.
DAR Mechanical Filters Membrane
Magnified Picture on Electron Microscope (x 3,500)
Principles of Mechanical Filtration

During mechanical filtration, the different-size germs are trapped thanks to three fundamental principles:

1) Direct interception (particles >1 µm):
   These particles are trapped directly because the average porosity of the filter membrane is smaller.

2) Inertial impact (particles <1 - 0,3> µm):
   Due to their mass, particles within this size range are trapped in the deep layers of the medium.

3) Diffusional interception (particles <0,3 µm):
   The particles within this size range move in a disorderly manner in the gas flow, thereby colliding with the fibres.
Principles of Mechanical Filtration

1. Direct interception
2. Inertial impact
3. Diffusional interception
Electrostatic Filtering Membrane

- The electrostatic filtering membrane is a filter medium specially designed to achieve a good filtration capacity with low flow resistance.

- The filter medium consists of a mesh of hydrophobic polypropylene fibres called Electret “Split” Fibres.
Electrostatic Filtering Membrane

Picture of electrostatic filter membrane enhanced on electron microscope
Mechanism of the Electrostatic Filtration

Thanks to the electrostatic filtration mechanism, the distance between the fibres is not crucial for the filtration efficiency.

Electrostatic filters have a high capacity in retaining particles and micro-organisms while offering a low resistance to air flow.
# Covidien DAR filters, FHMEs and HMEs

## Filters
- Electrostatic
  - Barrierbac
  - Barrierbac S
  - Barrierbac S-A
  - Barrierbaby

## FHME’s
- Hygrobac
  - Hygrobac S
  - Hygrobac S-A
  - Hygroboy
  - Hygrobaby

## HME’s
- Hygrolife II
- Flexlife
- Tracheolife II

## Mechanical
- Sterivent
  - Sterivent S
  - Sterivent Mini

- Hygroster
  - Hygroster Mini
Filtration Test Methods
Quality Concepts
NaCl Testing Method

- currently the uniquely accepted test method for assessing filtration performance of BSF
- filters are challenged with nebulised sodium chloride (NaCl) particles of the most penetrating particle size, i.e. 0.1 microns to 0.3 microns.
NaCl Testing Method

Expression of test results

- Penetration value: concentration of NaCl particles passing through the BSF as a percentage of the concentration in the challenge

- Percent filtration efficiency: 100 minus penetration value
Bacterial and Viral Filtration Efficiency Testing Methods

- No international standards to test bacterial/viral filtration efficiency of breathing system filters
- Tests can be performed “in vitro” (laboratory test) or “in vivo”
Laboratory Filtration Efficiency Test "In-Vitro"

MAIN PARAMETERS:

- **Bacterial or Viral "Challenge"**
  Number of micro-organisms (colony forming units) which actually reach the filter (value obtained without filter - "blank test")

- **Titre Reduction:**
  Number of micro-organisms (CFU) trapped by the filter

- **Bacterial or Viral Filtration Efficiency (BFE/VFE):**
  Percentage of bacterial or viral removal obtained by means of filter
Laboratory Filtration Efficiency Test "In-Vitro"

- BFE = 99%  ✔ passage of 1 micro-organism every 100
- BFE = 99.9%  ✔ passage of 1 micro-organism every 1,000
- BFE = 99.99%  ✔ passage of 1 micro-organism every 10,000
- BFE = 99.999%  ✔ passage of 1 micro-organism every 100,000
- BFE = 99.9999%  ✔ passage of 1 micro-organism every 1,000,000
Main factors:

1. Number of micro-organisms
2. Flow rate
3. Duration of suspension nebulization
4. Dimensions of pathogenic micro-organisms
5. Type of pathogenic micro-organisms
DAR:
100% QUALITY GUARANTEE

- During the manufacturing process, each single filter is tested
- All filters are accurately inspected by visual control
- Pressure test with 100 cm water column guarantees against possible leakages
- Integrity and efficiency of the mechanical membrane is tested by means of photometric control
DAR was the first manufacturer supplying Filters/HME’s and Filters STERILE

- Filters/HME’s are produced in a clean room class 100,000
- Filter/HME’s and Filters are then sterilised by means of an approved and validated sterilisation process with ethylene oxide (EtO)
- Sterility guarantees maximum safety on ventilated patients in operating theatres and ICUs
Tests against pathogens: Hepatitis C Virus

Hygrobac S
Hygrobac
Barrierbac S
Hygroster
Sterivent
Sterivent S
Sterivent Mini

- tested by HPA (CAMR) - Porton Down, UK -

have proven to be efficient against HCV
Tests against pathogens: HIV

Hygroster, Sterivent S, Sterivent Mini
- tested by Institut Pasteur de Lille, France -

and

Hygrobac S
- tested by HPA (CAMR) -

have proven to be efficient against HIV
Tests against pathogens:
Mycobacterium tuberculosis

Hygroster
Sterivent S
Sterivent Mini
Hygrobac S
- tested by IKI - Giessen, Germany -

and

Hygroster Mini
- tested by HPA (CAMR) –

have proven to be efficient against
Mycobacterium tuberculosis
DAR Quality Guarantee

Marking

The DAR Quality System has received TÜV Certification in accordance with EN ISO 13485:2003 Standard
Passive humidification
- It is generally accepted that a humidifying capacity of at least 30 mg H₂O/l is required for each tidal volume to prevent the thickening of secretions and possible lesions to the mucous membrane in intubated patients.

- ISO 9360-1:2000 Standard - no absolute values, possible recommendation of: not greater than 8mg/l of moisture loss.
HEAT AND MOISTURE EXCHANGERS:

Conserve heat and moisture during expiration and return them to inspired gases in the same way as a normal upper airway.

These are:

- **Hygroscopic**
  Cellulose (paper) element: absorbs water on expiration

- **Hydrophobic**
  Water repellent media – filtering media structured so as to repel water but allow passage of water vapour.
HEAT AND MOISTURE EXCHANGERS

Hygroscopic

- An element composed of paper, foam or other material with relatively low thermal conductivity
- The element can be impregnated with a hygroscopic chemical, usually calcium chloride
- The element absorbs water on expiration and water becomes then available to inspired gases
Hydrophobic

- A water repellent element with a large surface area and low thermal conductivity
- Latent heat of vaporisation is taken directly from the element and a temperature gradient develops within the element itself
- True hydrophobic HME’s are also efficient microbiological filters
HEAT AND MOISTURE EXCHANGERS

- Most HME’s are able to condition inspired gases to a level similar to that of normal nose breathing at rest.
- Efficiency, however, depends on inspired tidal, minute volume.
DAR HEAT AND MOISTURE EXCHANGERS:
Remove heat and moisture from expiratory gases and convey them to the inspiratory gases as occurs in the upper airways during physiological respiration

- High-performance HME’s feature a hygroscopic cellulose element
- Thanks to the special design of the cellulose, the capacity of the element is enhanced
EXCHANGE of HEAT & MOISTURE by means of a HYDROPHOBIC FILTER equipped with HYGROSCOPIC CELLULOSE ELEMENT

During expiration, the HME element retains heat and water vapour coming from the patient.
EXCHANGE of HEAT & MOISTURE by means of a HYDROPHOBIC FILTER equipped with HYGROSCOPIC CELLULOSE ELEMENT

During inspiration, heat and water are available to warm and humidify the inspired gases.
EXCHANGE of HEAT & MOISTURE
by means of a simple HYDROPHOBIC FILTER
without HYGROSCOPIC CELLULOSE ELEMENT

During expiration, part of the water vapour originating from the patient condenses on the filtering membrane, part on the expiration limb due to the lower temperature.
EXCHANGE of HEAT & MOISTURE by means of a simple HYDROPHOBIC FILTER without HYGROSCOPIC CELLULOSE ELEMENT

During inspiration, only a small amount of water vapour is available to humidify the dry and cold inspired gases. The HME effect is not sufficient in long term intubation.
Humidification
Test Methods
ISO 9360:1992 STANDARD represents the common standard for evaluating heat and moisture exchangers

ISO 9360-1:2000 STANDARD to be gradually implemented
By means of a standardised test system reproducing clinical ventilation conditions, the following parameters were tested:

- **Humidifying Capacity**
  - as moisture output in mg H$_2$O/l of gas at different TV values - 250 ml, 500 ml, 1000 ml

- **Resistance**
  - in dry and wet states at flows of 30 l, 60 l and 90 l

- **Compressible Volume** (dead space)
Flow Resistance
EACH FILTER OR COMBINED HMEF SHOWS A SPECIFIC FLOW RESISTANCE

- INSPIRATORY RESISTANCE must be overcome:
  - in conditions of controlled ventilation by the device
  - in conditions of partially-assisted ventilation by the patient
- EXPIRATORY RESISTANCE must be overcome:
  - always by the patients
- Flow resistance must be kept as low as possible for the entire utilisation period

- The filter or FHME should not show significantly high resistance even in the wet state

- The higher resistance is, the more work of breathing from the patient
Comparison between the Flow-Resistance in DRY Conditions of a combined hydrophobic/hygroscopic HMEF HYGROSTER - MDA Evaluation No. 142 - and a simple hydrophobic filter PALL BB 22-15 - MDA Evaluation No. 93 - in accordance with ISO 9360 standard
Comparison between the Flow-Resistance in WET Conditions of a **combined hydrophobic/hygroscopic HMEF** HYGROSTER - MDA Evaluation No. 142 - and a **simple hydrophobic filter** PALL BB 22-15 - MDA Evaluation No. 93 - *in accordance with ISO 9360 standard*
Filters, FHME’s, HME’s
Features & Benefits
### Covidien DAR filters, FHMEs and HMEs

#### Electrostatic Filters
- Barrierbac
- Barrierbac S
- Barrierbac S-A
- Barrierbaby

#### Mechanical Filters
- Sterivent
- Sterivent S
- Sterivent Mini

#### FHME’s
- Hygrobac
- Hygrobac S
- Hygrobac S-A
- Hygroboy
- Hygrobaby

#### HME’s
- Hygrolife II
- Flexlife
- Tracheolife II
- Hygroster
- Hygroster Mini
Mechanical Filters
Pleated Hydrophobic Membrane

- Very efficient - typically > 99.999%
- Small pore size
  - highest efficiency
  - can lead to high resistance unless large area of membrane is used
- The membrane is usually pleated to fit large membrane in the casing
- Highly hydrophobic (water repellent) - will not allow water across the membrane in any conditions
DAR Mechanical Filters

the Sterivent line

with pleated hydrophobic membrane
DAR mechanical filters with hydrophobic filter membrane for maximum hygienic protection during ventilation

**STERIVENT**
- Mechanical filter for adults
- Machine side
- Anesthesia/ICU

**STERIVENT S**
- Mechanical filter for adults with low dead space
- Machine/patient side
- Anesthesia/ICU

**STERIVENT MINI**
- Mechanical filter for adults and paediatric with low dead space
- Patient side
- Anesthesia
DAR Electrostatic filters

the Barrierbac line

- Efficiency > 99.9%
- Low resistance
- Round shape
- Hydrophobic material
# DAR Electrostatic filters

<table>
<thead>
<tr>
<th>BARRIERBAC</th>
<th>BARRIERBAC S</th>
<th>BARRIERBABY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic filter for adults</td>
<td>Electrostatic filter for adults</td>
<td>Electrostatic filter for neonatal and infant patients (VT 25-100 ml)</td>
</tr>
<tr>
<td>Machine side</td>
<td>Patient side</td>
<td>Patient side</td>
</tr>
<tr>
<td>Anesthesia /ICU</td>
<td>Anesthesia</td>
<td>Anesthesia</td>
</tr>
</tbody>
</table>
# Features and Benefits of DAR Filters

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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</thead>
<tbody>
<tr>
<td><strong>Sterivent range of mechanical filters</strong></td>
<td></td>
</tr>
<tr>
<td>Bacterial and Viral Filtration efficiency &gt; 99.999%</td>
<td>Prevents risk of cross contamination</td>
</tr>
<tr>
<td>High hydrophobicity = water repellant</td>
<td>Prevents passage of liquids for increased</td>
</tr>
<tr>
<td></td>
<td>protection</td>
</tr>
<tr>
<td>3 versions with different compressible volumes: Sterivent, Sterivent S,</td>
<td>The right product for every need</td>
</tr>
<tr>
<td>Sterivent Mini</td>
<td></td>
</tr>
<tr>
<td><strong>Barrierbac range of electrostatic filters</strong></td>
<td></td>
</tr>
<tr>
<td>Bacterial and Viral Filtration efficiency &gt; 99.99%</td>
<td>Prevents risk of cross contamination</td>
</tr>
<tr>
<td>Low flow resistance</td>
<td>Does not increase work of breathing</td>
</tr>
<tr>
<td>Round shape and lightweight</td>
<td>Patient comfort and reduced torque on</td>
</tr>
<tr>
<td></td>
<td>patient interface/tube</td>
</tr>
<tr>
<td>Comprehensive range</td>
<td>The right product for from neonatal to adult</td>
</tr>
<tr>
<td></td>
<td>patients</td>
</tr>
</tbody>
</table>
DAR Combined Filters/HME’s

Mechanical FHME

Electrostatic FHME’s
Clinical advantages with combined filter/HME

- no contamination …
  … of breathing systems
  … of ventilators/anaesthesia machines
  … of the environment

- no cross-contamination …
  … between patients
  … between patients and hospital staff
Clinical advantages with combined filter/HME

- physiological humidification and warming of respiratory gas

  - Anaesthesia
    - no hypothermia
    - easier post-operative care

  - Intensive Care
    - no risk of overheating or overhumidification with humidifier
Economical advantages with combined filter/HME

- reduced maintenance and labour costs
  - no sterilisation of breathing systems
  - no sterilisation of equipment

- extended life of equipment
  - lower capital equipment costs
  - no hot water humidifier and spare parts
DAR Mechanical Filter/HMEs

HYGROSTER

Mechanical filter combined with highly hygroscopic membrane for humidification and superior microbiological barrier

Patient side

Anesthesia/ ICU

HYGROSTER MINI

Mechanical filter combined with hygroscopic membrane for humidification and microbiological barrier, with reduced volume for adults and pediatric

Patient side

Anesthesia/ ICU
**DAR Electrostatic Filter/HMEs**

<table>
<thead>
<tr>
<th><strong>HYGROBAC</strong></th>
<th><strong>HYGROBAC S</strong></th>
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<tbody>
<tr>
<td>Electrostatic filter combined with hygroscopic membrane for humidification and microbiological barrier patients &gt;30kg</td>
<td>Electrostatic filter combined with hygroscopic membrane for humidification and microbiological barrier, with reduced volume, patients &gt;20kg</td>
</tr>
<tr>
<td>Patient side</td>
<td>Patient side</td>
</tr>
<tr>
<td>Anesthesia/ ICU</td>
<td>Anesthesia/ ICU</td>
</tr>
</tbody>
</table>
DAR Electrostatic Filter/HMEs

**HYGROBOY**
Electrostatic filter combined with hygroscopic membrane for humidification and microbiological barrier, for children with a tidal volume between 75-300 ml, patients 8-30 kg

**HYGROBABY**
Electrostatic filter combined with hygroscopic membrane for humidification and microbiological barrier, for babies with a tidal volume between 30-100 ml, patients 3-8 kg

Patient side
Anesthesia/ ICU

Patient side
Anesthesia/ ICU
Hygrolife II

- **Features:**
  - Light and compact
  - End Tidal CO₂ sampling port

- **Advantages:**
  - High humidification efficiency
  - No need for active humidifiers
  - Cost effectiveness

- **Cost saving:**
  - Reduced capital equipment expense
  - Allows the use of simpler breathing systems
DAR HMEs

Tracheolife II

- HME for spontaneously breathing tracheostomized patients
- High humidification efficiency
- Built-in port for endotracheal suctioning and sampling
- Possibility to heat and humidify the oxygen
DAR HMEs

Tracheolife II

- Compact and lightweight
- Particularly suitable for ambulatory patients
- Efficient even in the presence of secretions
- Single use device, complete with oxygen port in such a position as to allow heating and humidification
- New conception: in case of sputum, its functionality is not compromised
- Easy and non-traumatic replacement
- Sampling and suctioning can be performed without removing it
DAR HMEs

Flexlife

- For use with ventilated patients (ICU and theatres)
- High moisture output
  >30 mg H₂O/l
- Light weight and simple to use
- Integral catheter mount with memory and variable dead space
- Reduced capital equipment expense
- Allows the use of simpler breathing systems
<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
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<tr>
<td>Patented design of hygroscopic cellulose element increases HME surface</td>
<td>Improves patient outcome</td>
</tr>
<tr>
<td>and provides optimal moisture output</td>
<td></td>
</tr>
<tr>
<td>Low moisture loss with no condensation within tubing</td>
<td>Avoids bacterial growth and reduces staff workload</td>
</tr>
<tr>
<td>Full range when including combined FilterHME version</td>
<td>The right product for every patient need and streamlined</td>
</tr>
<tr>
<td></td>
<td>supply source</td>
</tr>
<tr>
<td>Bacterial and Viral Filtration efficiency &gt; 99.99% for combined FHMEs</td>
<td>Prevents risk of cross contamination</td>
</tr>
<tr>
<td>Tracheolife II HME for spontaneously breathing trachestomized patients</td>
<td></td>
</tr>
<tr>
<td>Built-in port for endotracheal suctioning and sampling</td>
<td>Procedure can be performed without removing it. Functions</td>
</tr>
<tr>
<td></td>
<td>also in presence of sputum</td>
</tr>
<tr>
<td>Position of oxygen port allows heating and humidification</td>
<td>Improved outcome and comfort</td>
</tr>
</tbody>
</table>

*Tracheolife II HME for spontaneously breathing trachestomized patients*
Filters, FHME’s, HME’s
How to sell against
Customer Needs

**Patients**
Ventilated patients – ICU, Anaesthesia

**Physicians:**
ICU Clinicians
RT
Anesthesiologist
Intensivist

**Nurses:**
Head nurse
ICU nurse

Key needs and requirements the physicians/nurses have with these type of patients

1. Improve patient outcome
2. Reduce nosocomial infections
3. Avoid cross contaminations
4. Time and cost saving
5. Solutions for all kind of patients
Why Buy DAR Filters?

**Key Features**
1) High filtration performance
2) Effective HME
3) Full range
4) Electrostatic complete range of filters and filterHMEs

**Benefits**
1) Minimize cross contamination and nosocomial infections
2) Improve patient outcomes.
3) Streamlined supply source
4) Cost effective solution to save time when compared with active humidification
What’s your customer segment?

### Key Factors

- Is your customer willing to discuss which filter could be the most appropriate before jumping to “how much does it cost”?
- Is your customer used to buy high tech/quality products? (check its ward’s equipment tech level)
- Is your customer proactively asking for products/procedures to reduce nosocomial infections?
- Is your customer usually highly concerned about staff/patients safety?

**NO**

- Price oriented customers

**YES**

- Performance/quality oriented customers
Key Messages

- Full range availability to cover all needs of filtration and passive humidification at a cost effective solution to simplify and streamline procedures, resulting in saving time and money. With DAR truly FilterHME no alarms to care for nor high running costs to endorse as with active humidification.

- Filters of choice:
  - **ICU** - Hygrobac and Hygrobac S (Hygroboy and Hygrobaby)
  - **Anaesthesia** - Barrierbac and Barrierbac S (Barrierbaby)

Key Messages

- Top FilterHMEs (Heat and Moisture Exchangers) to contribute in shortening patients’ outcome.

- The highest protection for hospital staff and patients against cross contamination thanks to high performance filtering membranes.

- Filters of choice:
  - **ICU** - Hygroster Mini and Hygroster
  - **Anaesthesia** - Sterivent and Sterivent Mini

Why Buy DAR Filters?
Q&A

**Doc: Is top HME performances coming to a high price?**

Rep: No, on the contrary, our electrostatic FilterHMEs can satisfy the highest HME standards at affordable prices.

**Doc: How often do I have to change the FilterHME?**

Rep: Once a day, and its running cost will be far less expensive than any active humidifier with a simple and straightforward protocol to save your time.

**Doc: Can I grant sufficient humidity to my patients?**

Rep: Yes, you can when using a truly FilterHME. Moisture and heat loss should be the lowest possible. Just when patients are critical and very poorly hydrated then chose an active humidification solution. We would never encourage you to compromise on you patient safety.

**Doc: I already use your competitor products, why should I use yours.**

Rep: Because along with top filtration performances we can grant the highest levels of humidification...
Why Buy DAR Filters?

Proof Sources:

• MHRA independent evaluation/comparison of available filters on the market.

• Test reports on specific virus and bacteria produced by the major independent and worldwide recognized laboratories in this field such as:
  * HPA – Health Protection Agency, former CAMR - UK
  * Nelson Laboratories Inc. - USA
  * MHRA – previously know as MDA – UK
  * Institut Fresenius Chemische und Biologische Laboratorien - Germany

• Several publications from various universities and research centers. The full literature is available on the InfoProd CD-Rom.

• Internal HME performance evaluation and NaCl testing based on ISO standards
Main competitors:

Intersurgical

Teleflex – Hudson RCI - Gibek

Pall

Medisize