Protective Materials

International Finance Corporation, May 4th 2020

1) Company overview - Hans Sohlström, President & CEO
2) Protective materials - Lionel Bonte, Vice President, Medical
3) Face mask materials - Giuseppe Costa, Vice President, Filtration
Global leader in sustainable and innovative fiber-based solutions

- Fibers are at the core of what we do and the common denominator for our products and solutions
- Natural fibers represent 95% of our total fiber use
- We offer custom made specialized fiber based materials
- Our value proposition is based on innovation, quality and service
- Our offering contributes to a more sustainable everyday life

Key facts
- Global network of sales offices and 45 plants in 14 countries
- Approximately 8,000 employees, 48 nationalities
- More than 7,000 customers in over 100 countries
- Pro forma 2019 net sales of approximately EUR 3 billion
- Shares listed on Nasdaq Helsinki and Stockholm
- Head office in Helsinki, Finland, Europe

Key strengths
- Leading positions in chosen segments
- Operating on growing markets
- Balanced geographical exposure to a broad range of end-uses
- Designed sustainable and innovative customer solutions
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Product offerings
Providing operating rooms and laboratories globally a high level of infection protection with our single-use medical fabrics.

- High Performance Surgical Gowns & Apparel (BVB)
- Bi-laminate Barrier Apparel & Drapes
- Moderate Protection Surgical Apparel (SMS)
- Surgical Drapes
- Personal Protective Apparel
- Pleated Surgical Face Masks Fabric
- Sterile Barrier Systems
- Converting
Ahlstrom-Munksjö participates in Drapes and Gown market as a paper manufacturer, ONLY. We do not convert nor distribute.

In the Sterile Wrap market Ahlstrom-Munksjö participates as a paper manufacturer, as well as a converter.
Viral protection options

AAMI LEVELS OF PROTECTION

1. **Minimal risk**, to be used during basic care, standard isolation, cover gown for visitors, or in a standard medical unit

2. **Low risk**, to be used during blood draw, suturing, in the Intensive Care Unit (ICU), or a pathology lab

3. **Moderate risk**, to be used during arterial blood draw, inserting an intravenous (IV) line, in the Emergency Room, or for trauma cases

4. **High risk**, to be used during long, fluid intense procedures, surgery, when pathogen resistance is needed or infectious diseases are suspected (non-airborne)

### Basic Viral Protection
- Meant for light fluid environments
- Film is not breathable – limited robustness

### Enhanced Viral Protection
- Meant for heavy fluid environments
- Film laminates are protective - but uncomfortable because they don't breathe. Therefore typically used in short duration activities because of low comfort.

### Chemical Biological Radiological/Nuclear
- Passes relevant CBRN coverall requirements
- Film laminate may or may not be breathable

### Advanced Breathable Viral Barrier
- Meant for heavy fluid environments
- Film laminate is breathable for long duration wear
Medical fabrics for different levels of barrier protection

Level 1
Basic performance
- Lightweight Spunbond Meltblown Spunbond (SMS)
- Lightweight Spunbond
- Untreated SMS
- Anti-Static SMS

Level 2
Medium performance
- Treated SMS
- Wetlaid

Level 3
High performance and comfort
- Soft Alcohol Repellent / Anti-Static SMS
- Regular Alcohol Repellent / Anti-Static SMS

Level 4
Ultimate performance with viral protection
- Films
- Non-Breathable Laminates
- Breathable Viral Barrier (BVB) film-based laminate

Viruses. Bacteria. Fluids. Ahlstrom-Munksjö has you covered.
**Protection and Comfort**

**High Performance SMS**
Ahlsstrom-Munksjö has a long track record of providing high performance SMS ( spunbond meltblown spunbond) fabric to protect medical personnel from operating room liquids while keeping them comfortable. We have used this expertise to develop SMS fabric that meets the requirements of EN 13034: Clothing for Protection Against Liquid Chemicals and EN 13982: Protective Clothing for Use Against Solid Particulates.

**TrustShield™ Chemically Resistant Laminates**
Ahlsstrom-Munksjö manufactures a wide range of bilaminates and trilaminates as per industry standards and specifications. These laminates offer the best protection when working with a wide variety of chemicals. Several of these fabrics have been tested against and are impervious to the strongest chemotherapy drugs available on the market.

**ViroSél™ Breathable Viral Barrier**
Breathable Viral Barrier is a unique fabric: it is strong, soft, highly breathable and provides excellent barrier properties against viruses causing infectious diseases such as HIV/AIDS (Human Immunodeficiency Virus), H1N1 and Avian Influenza.

The outer layer provides water repellancy and strength. The inner layer is soft and comfortable when worn during long surgical procedures. The barrier layer is a membrane which has a monolithic, non-porous structure that provides an impervious barrier, thus blocking the passage of viruses and bacteria.

The structure of the film allows moisture vapor to pass through, allowing the wearer to remain comfortable while providing the highest level of protection.

**PureArmor™ Impervious Breathable Fabric**
PureArmor™ Breathable Fabric is Ahlsstrom-Munksjö’s proprietary fabric specifically developed for critical environments. It is strong, soft, highly breathable and provides excellent barrier to protect both the wearer and the working environment. The proprietary design is low lint and is rated as Class 2 by Heimtex Drum Testing.

Compared to other breathable fabrics like Flashspin High-Density Polyethylene and SMS, PureArmor™ provides a significantly better barrier to fluids, bacteria and viruses. Additionally, the impervious monolithic design stops particles being emitted by the user to enter a sensitive environment like a cleanroom.
# Ahlstrom-Munksjö Medical Barrier Fabrics. For surgical, lab and clinical environments.

<table>
<thead>
<tr>
<th>Product</th>
<th>Application</th>
<th>Construction</th>
<th>Description</th>
<th>Basis Weight</th>
<th>Certification Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>ViroSēl™ Breathable Viral Barrier (BVB)</td>
<td>Surgical gown</td>
<td>Monolithic Film Tri-laminate (SMS, Bico or PP Spunbond nonwovens)</td>
<td>Tri-laminate fabric with a monolithic film designed to provide impervious (AAMI level 4) protection especially for highly critical areas.</td>
<td>50 – 70 gsm</td>
<td>PB 70 AAMI Level 4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EN 13795 – High Performance Critical Zone</td>
</tr>
<tr>
<td>PureArmor™ BVB</td>
<td>Personal protective apparel for sensitive environments</td>
<td>Monolithic Film Tri-laminate (SMS, Bico Spunbond nonwovens)</td>
<td>Tri-laminate fabric with a monolithic film for superior protection (ASTM 1671). Specially designed technology that achieves extremely low levels of lint.</td>
<td>62 - 52 gsm</td>
<td>EN 14126</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>ASTM 1671</td>
</tr>
<tr>
<td>TrustShield™</td>
<td>Surgical drape or gown, personal protective apparel</td>
<td>Film Bi-laminate (Spunbond or SMS nonwovens)</td>
<td>Highly absorbent, viral (AAMI level 4), chemical and puncture resistant with virtually no lint. Chemotherapy drug and laser resistant.</td>
<td>40 - 60 gsm</td>
<td>ASTM 1670</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>ASTM 6978</td>
</tr>
<tr>
<td>TenderGuard™</td>
<td>Surgical gown or drape</td>
<td>AR/AS treated SMS</td>
<td>SMS multilayer nonwoven fabric offering a high level of protection, low lint, and superior strength and repellency to blood and other low surface tension liquids.</td>
<td>20 - 55 gsm</td>
<td>PB 70 AAMI Level 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>EN 13795 – Standard Performance Critical Zone</td>
</tr>
<tr>
<td>VaporCool™</td>
<td>Surgical scrub suit</td>
<td>AS treated SMS</td>
<td>SMS fabric with an innovative layer called, Adaptive™, a hydro-functional polymer that captures and distributes moisture.</td>
<td>20 - 55 gsm</td>
<td>EN 13795 – Standard Performance Non-Critical Zone</td>
</tr>
<tr>
<td>Face Mask</td>
<td>Surgical face mask</td>
<td>Wetlaid</td>
<td>Hypoallergenic fabric that is smooth and soft, ideal for sensitive skin contact.</td>
<td>18 - 20 gsm</td>
<td>N/A</td>
</tr>
<tr>
<td>Product</td>
<td>Certification Level</td>
<td>Description</td>
<td></td>
<td></td>
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<td>---------</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td><strong>ViroSēl™ Breathable Viral Barrier (BVB)</strong></td>
<td>PB 70 AAMI Level 4 EN 13795 – High Performance Critical Zone</td>
<td>AAMI PB70/AAMI Level: Liquid barrier performance and classification of protective apparel and drapes intended for use in health care facilities. This standard establishes a system of classification for protective apparel and drapes used in health care facilities based on their liquid barrier performance and specifies related labeling requirements and standardized test methods for determining compliance. The ANSI/AAMI PB70 standard includes four standard tests to evaluate the barrier effectiveness of surgical gowns, isolation gowns, and surgical drapes. Based on the results of these standardized tests, four levels of barrier performance are defined, with Level 1 being the lowest level of protection, and Level 4 being the highest level of protection. The Association for the Advancement of Medical Instrumentation (AAMI) Level 4 is the highest level protection for surgical gowns. To be qualified as AAMI Level 4, the surgical gown must have ASTM 1671 level protection in 4 critical zones: front chest, sleeve seam, sleeve, and front belt attachment point. The European standard, EN 13795, addresses the barrier properties, cleanliness, and strength of surgical drapes, gowns, and clean air suits used to protect patients from secondary infections in the surgical suite. 8 tests required to meet the EN 13795 standard: Resistance to Dry Microbial Penetration, Resistance to Wet Bacterial Penetration, Bioburden, Particle Shed Analysis, Hydrostatic Pressure, Hydraulic Burst Test, Tensile Test, Dry, Tensile Testing.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>PureArmor™ BVB</strong></td>
<td>EN 14126 ASTM 1671</td>
<td>This standard is used to demonstrate the performance of protective garments against infective agents. This is not a ‘stand-alone’ standard and needs to be combined with additional standards: Resistance to wet microbial penetration, Resistance to liquid aerosol penetration and Resistance to dry microbial penetration. American Society for Testing and Materials (ASTM) sets international technical standards for a wide range of materials, products, systems, and services. Specifically, the ASTM 1671 test method measures the resistance of materials used in protective clothing to penetration by blood-borne pathogens.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TrustShield™</strong></td>
<td>ASTM 1670 ASTM 6978</td>
<td>ASTM 1670 Standard Test Method for Resistance of Materials Used in Protective Clothing to Penetration by Synthetic Blood. This test method is based on Test Method F903 for measuring resistance of chemical protective clothing materials to penetration by liquids. This test method is normally used to evaluate specimens from individual finished items of protective clothing and individual samples of materials that are candidates for items of protective clothing. ASTM 6978 Protocol for the assessment of resistance of medical glove materials to permeation by potentially hazardous cancer chemotherapy drugs under conditions of continuous contact. The standard details: ▪ which chemotherapy drugs should be used to evaluate PPE used in chemotherapy ▪ concentration of each drug ▪ temperature of the drug during the test ▪ breakthrough detection limit</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>TenderGuard™</strong></td>
<td>PB 70 AAMI Level 3 EN 13795 – Standard Performance Critical Zone</td>
<td>See above under ViroSēl™ – level 3 protection vs level 4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>VaporCool™</strong></td>
<td>EN 13795 – Standard Performance Non-Critical Zone</td>
<td>See above under ViroSēl™ – protection level low</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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Contaminants in the air

- **Definition**

  Suspension of particles containing biological agents which have been dispersed in a gas

- **Transmission Pathways**

<table>
<thead>
<tr>
<th>Indirect/Direct: Droplets</th>
<th>Transmission through air or direct contact by sneezing, couching, speaking, breathing Large size droplets (&gt; 5 µm) and projected up to about 1m.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><em>Examples of infections: Meningococcus, pertussis, influenza, respiratory viruses</em></td>
</tr>
<tr>
<td>Indirect: Airborne particles</td>
<td>Transmission via aerosols by sneezing, couching, speaking, breathing or through poure maintained HVAC systems Small size airborne particles = droplets nuclei (&lt;5µm) and projected up to several meters</td>
</tr>
<tr>
<td></td>
<td><em>Examples of infections: tuberculosis, measles, chickenpox, smallpox</em></td>
</tr>
</tbody>
</table>

Need of Specific Face mask to protect against the different environment and Contaminants
Face mask Classification: Two main types of Face Masks widely used

- **Surgical Mask (SM)**
  - **Definition:** Medical device covering the mouth, nose and chin providing a barrier to minimize the direct transmission of infective agents from the mask wearer to the environment
    - Medium Efficiency Protection mainly at 1 and 3 micron
    - Soft touch and High permeability (high breathability)
    - Composed normally by 3 layers

Examples: surgical and procedure masks, isolation masks, laser masks, dental masks, patient care masks

- **Personal Protective Equipment (PPE)**
  - **Definition:** Medical device that covers the nose and mouth or the entire face or head and designed to protect the individual wearer against inhalation of both hazardous solid and liquid aerosols in the workplace (microorganisms, dusts, vapors, gas)
    - High efficiency protection at 0.3 microns
    - Stiffer and more ergonomic adhesion to the face
    - Composed by several layer
Normatives and testing procedures

<table>
<thead>
<tr>
<th>EN 14683:2019</th>
<th>Type I</th>
<th>Type II</th>
<th>Type IIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BFE%</td>
<td>&gt;95</td>
<td>&gt;98</td>
<td>&gt;98</td>
</tr>
<tr>
<td>DP, Pa/cm²</td>
<td>&lt;40</td>
<td>&lt;40</td>
<td>&lt;60</td>
</tr>
<tr>
<td>Air perm, l/sm²</td>
<td>&gt;280</td>
<td>&gt;280</td>
<td>&gt;190</td>
</tr>
<tr>
<td>Splash resistance</td>
<td>none</td>
<td>none</td>
<td>&gt;16</td>
</tr>
</tbody>
</table>

Filtration test = 3 micron aerosol containing bacteria
result with bacterial count before / after filter media → Bacterial Filtration Efficiency

Breathability = based on air permeability or pressure drop

Splash resistance = repellency to blood

<table>
<thead>
<tr>
<th>EN149:2009</th>
<th>Minimum efficiency of test aerosol @ 95 lt/min</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NaCl</td>
</tr>
<tr>
<td>FFP1</td>
<td>80%</td>
</tr>
<tr>
<td>FFP2</td>
<td>94%</td>
</tr>
<tr>
<td>FFP3</td>
<td>99%</td>
</tr>
</tbody>
</table>

Filtration test = 0,3 micron polydisperse aerosol on face mask - 8 cm/s face velocity

Breathability = based on pressure drop on mask

Additional requirement for DPI:
- Flammability
- Clogging test
- Breathability after clogging
- Leakage
- …
Composition of Surgical Masks

Three layers

- **Outer layer:** Spunbond, Wetlaid
- **Medium filtration layer:** Melt Blown Fine Fiber with fibers in the nano dimension
- **Inner layer:** Wetlaid, Spunbond

*Nose clips* for face fit and to avoid leakage

*Elastic ear loops* or adjustable ties

+ water-repellent treatment
+ anti-fog splash visor
Ahlstrom-Munksjo product offering

- **Inner Layer**: we offer products with different characteristics in wet laid or Needlepunch. Main properties soft touch and moldable ergonomic shape and actic as prefilter for inside to outside.

- **Filter media**: we have several type of Fine fiber Meltblow in PP or PBT to reach Type I, II, IIR and also FFP2 efficiency level

- **Outer layer**: normally incorporated during the filter media production and we have anyway ppunbond or moldable wet laid
Testing equipment

- Bacterial Filtration Efficiency
- Differential Pressure
- Splash resistance
## Face mask manufacturing

<table>
<thead>
<tr>
<th>Typical type of masks</th>
<th>Pleated (tie-on, ear-loop)</th>
<th>Duck shape</th>
<th>Spherical/cup masks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Related existing standards</td>
<td>Surgical (EN14683) Civil (no standards)</td>
<td>Surgical (EN14683) Respirator (EN149) Civil (no standards)</td>
<td>Surgical (EN14683) Respirator (EN149) Civil (no standards)</td>
</tr>
<tr>
<td>Manufacturing technology</td>
<td><strong>Ultrasonic welding (typical)</strong> Sewing is also done (mostly in case of civil mask where textile is used)</td>
<td><strong>Ultrasonic welding (typical)</strong> Sewing is also done (mostly in case of civil mask where textile is used)</td>
<td>Thermoforming + sonic (or heat?) welding</td>
</tr>
</tbody>
</table>
Civilian Mask

The less technically demanding segment where nationals norms are emerging (FR, SP, I)

Countries are organizing internal normatives to create different protective devices for the correct use by people.

Filtration test = Idea is to look into 1 and 3 micron aerosol filtration test and have an average at only aerosol testing (depending on countries from 80 to 90%)

Breathability = allowing the lowest breathability sustainable for people for example the FFP3 breathability instead of Type II surgical

Other properties = efficiency, stability, no washing allowed, repellency.
Summary

1. Global leader in sustainable and innovative fiber based solutions
2. Infection protection medical fabrics
3. Face mask materials for respiratory, surgical and civil use
Thank you
Smart solutions out of fibers