UniTech R3 Workshop

“Fulfill the Nuclear Promise” June 5th - 7th, 2019
MCS COMFORT FACTOR
Taking UniTech’s CoolTech Fabric Performance To The Next Level with Burlington’s MCF
• THERMO-PHYSIOLOGICAL COMFORT
• ENGINEERING PERFORMANCE
  • Comfort Through Adsorption
  • Moisture Management Through Capillary Action
  • Engineering Comfort with Synthetics
  • MCS® Technologies/Cooling Mechanisms
• MCS COMFORT FACTOR (MCF)
  • Standard Test Methods
  • Quantifying Performance / Comfort
  • Unitech CoolTech Versus Top Competitors
• QUESTIONS
Thermo-Physiological Comfort

**Thermo-physiological comfort:**
The metabolic heat and moisture produced by the human body is in balance with the heat and moisture loss from the skin surface. Human comfort is related to skin temperature (Heat) and wetness perception (Moisture).

**Performance Fabric Demands**
- Maintain breathability
- Transport sweat from skin to fabric
- High evaporation rate
- Short dry times
- Thermal energy transfer
  - Conduction, Convection & Radiation

Faster the fabric Wick and Adsorb moisture

More surface area the moisture cover

Faster evaporation of the moisture

Quicker evaporation of sweat from skin

Cool sensation/ dry and comfort
ENGINEERING PERFORMANCE

How we engineer fabrics with enhanced comfort
Absorption

Allows fibers to uptake and retain water (water diffuses into fiber) depends on their chemical affinity.

Hydrophilic (water loving) fibers such as cotton absorb more water.

**Cotton High Water Absorbency = High Dry Time**
**High Moisture Regain = Wetness Perception**

Adsorption

Moisture is transported *over* the surface and *between* the fibers.

The surface of synthetic fibers are modified by hydrophilic chemistries (MCS technology).
**Wicking**: The movement of water through fabric, which is identified with the ability of fabric to maintain capillary flow.

Moisture can be transferred from the inner surface to the outer surface of the fabric.

The fiber type, fabric design & applied finishes play a key role regarding wicking properties.

**Polyester & Nylon**
- High Breathability
- Effectively Transport Water
Fiber types

Synthetic versus natural fibers

Fiber morphology

Increasing the fiber’s surface area by reducing fiber diameter or by changing the shape of its cross-section. Ex: microfibers, hollow fibers, channeled fibers

- Air permeability, wicking and drying rate are all influenced by the number & dimension of filaments
- More filaments/fibers in yarn results in more surface area

Yarn type

- Yarn twist affects wicking properties where both low & highly twisted yarns presents lower wicking ability
- Textured yarns provide better aesthetics and performance (MCS properties)

Fabric Construction

- Plain structure and more filaments with lower linear density = greater capillary action
- Thinner and more porous fabrics present better moisture vapor transmission
- Blends

Finishing Technology

- Chemically and physically treating fabrics can alter moisture management properties
Heat/Cool by respiration and evaporation mechanism
Hydro functional polymers

Heat/Cool by solution
Multilayer structure of sugar alcohols

Heat/Cool by evaporation + melting mechanism
Melting Material

Heat/Cool by conduction/irradiation/reflection
Cooling Minerals permanently embedded to the fibers

Next Generation
MCS COMFORT FACTOR (MCF)

Taking UniTech’s CoolTech Fabric Performance To The Next Level
with Burlington’s MCF
What is moisture management fabric?
Fabric made of fibers with hydrophilic surface which can efficiently transfer moisture from a skin-fabric interface to an atmosphere-fabric interface

How to evaluate?

**How fast can liquid spread out?**
Absorbency (AATCC 79)
Wetting Time, Spreading speed, Wetted Radius (AATCC 195)
Efficient wicking vertical (AATCC 197)

**How fast can liquid evaporate?**
Dry time (AATCC 199)
Dry Rate (AATCC 201)
Dynamic Evaporation Test (For MCS-Adaptive)

**How good is the air flow through the fabric?**
Air permeability: (ASTM D737)
MCS COMFORT FACTOR (MCF) – Standard Test Methods (USA)

**Absorbency (AATCC 79)**
Take the water (liquid) in and retain the water (sec)

**Wetting Time, Spreading speed, Wetted Radius (AATCC 195)**
- Rate of surface wetting from the center (drop of liquid) to the maximum wetted radius (mm/sec)
- Maximum radial spreading (mm)

**Efficient wicking vertical (AATCC 197)**
- Movement of liquid through porous by capillary action / upward movement of liquid from cut edge (mm)

**Dry time (AATCC 199)**
Specific amount of liquid to evaporate from fabric under control condition (min)

**Dry Rate (AATCC 201)**
Rate at which liquid evaporates from fabric with heated plate at 37°C (ml/h)

**Dynamic Evaporation Test (For MCS-Adaptive)**
Evaporation of specific amount of water on MCS-Adaptive Vs control fabric at 2 different temperatures (% @ 15min)

**Air permeability: (ASTM D737)**
Tendency of fabric to allow air and/or moisture to pass through (cm³/s/cm²)
## MCS COMFORT FACTOR (MCF) – Quantifying Performance / Comfort

### What is MCS Comfort Factor?

Raw data is collected for each test parameter using standard test method.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test Method</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Permeability</td>
<td>ASTM D737 (cfm/ft²)</td>
<td>21.33, 17.03, 13.17, 23.50, 17.27, 19.90</td>
</tr>
<tr>
<td>Martindale Abrasion</td>
<td>ASTM D4966 (cycles)</td>
<td>+100,000, +100,000, +100,000, +100,000, +100,000, +100,000</td>
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<tr>
<td>Absorbency - Original</td>
<td>AATCC 79 (sec)</td>
<td>1, 1, 1, 1, 1, 1</td>
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<tr>
<td>Absorbency - 3X</td>
<td></td>
<td>2, 2, 2, 2, 2, 1</td>
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<tr>
<td>Wetting Time Top</td>
<td>AATCC 195 (Sec)</td>
<td>2.65, 3.62, 2.6, 7.3, 2.52, 4.71</td>
</tr>
<tr>
<td>Wetting Time Top Wash/ Rinse</td>
<td></td>
<td>4.92, 2.82, 3.48, 3.93, 3.81, 3.51</td>
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<tr>
<td>Wetting Time Bottom</td>
<td></td>
<td>3.38, 6.21, 5.05, 6.17, 2.54, 2.86</td>
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<tr>
<td>Wetting Time Bottom Wash/ Rinse</td>
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<td>4.88, 2.86, 3.51, 4.2, 3.98, 3.65</td>
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<tr>
<td>Absorption Rate Top</td>
<td>AATCC 195 (%/Sec)</td>
<td>30.17, 19.61, 22.39, 10.66, 50.65, 35.81</td>
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<tr>
<td>Absorption Rate Top Wash/ Rinse</td>
<td></td>
<td>28.09, 24.71, 25.23, 26.2, 34.95, 33.83</td>
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<tr>
<td>Absorption Rate Bottom</td>
<td></td>
<td>48.97, 24.36, 51.34, 24.72, 47.11, 36.63</td>
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<tr>
<td>Absorption Rate Bottom Wash/ Rinse</td>
<td></td>
<td>38.47, 29.52, 32.29, 38.73, 41.88, 42.95</td>
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<tr>
<td>Wetted Radius Top</td>
<td>AATCC 195 (mm)</td>
<td>21, 26, 25, 25, 25, 25</td>
</tr>
<tr>
<td>Wetted Radius Top Wash/ Rinse</td>
<td></td>
<td>21, 17.14, 20.83, 25, 25, 30</td>
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<tr>
<td>Wetted Radius Bottom</td>
<td></td>
<td>21, 25, 25, 25, 25, 25</td>
</tr>
<tr>
<td>Wetted Radius Bottom Wash/ Rinse</td>
<td></td>
<td>21, 25, 25, 25, 25, 25</td>
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<tr>
<td>Spreading speed Top</td>
<td>AATCC 195 (mm/Sec)</td>
<td>4.85, 3.26, 4.95, 1.37, 6.04, 7.29</td>
</tr>
<tr>
<td>Spreading speed Top Wash/ Rinse</td>
<td></td>
<td>4.13, 6.25, 4.76, 3.76, 5.49, 4.2</td>
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<tr>
<td>Spreading speed Bottom</td>
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<td>5.39, 4.59, 4.24, 4.64, 5.88, 6.96</td>
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<tr>
<td>Spreading speed Bottom Wash/ Rinse</td>
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<td>3.97, 6.39, 4.91, 3.66, 5.79, 4.21</td>
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<tr>
<td>Vertical Wicking Warp</td>
<td>AATCC 197 (min)</td>
<td>19, 14, 14, 14, 9, 13</td>
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<tr>
<td>Vertical Wicking Warp Wash/ Rinse</td>
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<td>14, 9, 19, 9, 9, 14</td>
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<tr>
<td>Vertical Wicking Fill</td>
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<td>9, 9, 14, 9, 9, 19</td>
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<tr>
<td>Vertical Wicking Fill Wash/ Rinse</td>
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<td>19, 14, 14, 14, 19, 14</td>
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<tr>
<td>Vertical Wicking Fill Wash/ Rinse</td>
<td></td>
<td>28:29:0, 28:21:00, 27:24:00, 30:33:00, 30:00:00, 29:00:00</td>
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</tbody>
</table>
What is MCS Comfort Factor?

Raw data is collected for each test parameter using standard test method.

We generate a normalizing formula to convert raw data to a normal scale 1 to 10. The higher the number is better.
<table>
<thead>
<tr>
<th></th>
<th>Burlington</th>
<th>CoolTech</th>
<th>Woven #1</th>
<th>Woven #2</th>
<th>Nonwoven #3</th>
<th>Nonwoven #4</th>
<th>Nonwoven #5</th>
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</thead>
<tbody>
<tr>
<td>Thickness (mm)</td>
<td>0.19</td>
<td>0.22</td>
<td>0.33</td>
<td>0.32</td>
<td>0.36</td>
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<td>Fabric Weight (OZ/SY)</td>
<td>2.72</td>
<td>3.84</td>
<td>4.95</td>
<td>2.02</td>
<td>1.95</td>
<td>2.16</td>
<td>2.16</td>
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<tr>
<td>Wetting Time (Top)</td>
<td>6</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>5</td>
<td>6</td>
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<tr>
<td>Absorption Rate (Top)</td>
<td>4</td>
<td>1</td>
<td>7</td>
<td>10</td>
<td>6</td>
<td>5</td>
<td>6</td>
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<tr>
<td>Wetted Radius (Top)</td>
<td>10</td>
<td>2</td>
<td>7</td>
<td>1</td>
<td>7</td>
<td>7</td>
<td>7</td>
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<tr>
<td>Spreading speed (Top)</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>5</td>
<td>5</td>
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<tr>
<td>Dry Time (Modified AATCC 199)</td>
<td>9</td>
<td>4</td>
<td>1</td>
<td>1</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Dry Rate (AATCC 201)</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>10</td>
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<td>10</td>
<td>10</td>
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<tr>
<td>Air Permeability (ASTM D-737)</td>
<td>4</td>
<td>7</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td><strong>Burlington MCS Comfort Factor</strong></td>
<td><strong>63.24</strong></td>
<td><strong>25.68</strong></td>
<td><strong>42.7</strong></td>
<td><strong>32.97</strong></td>
<td><strong>45.95</strong></td>
<td><strong>47.57</strong></td>
<td><strong>47.57</strong></td>
</tr>
</tbody>
</table>
What can our fabric do for you?

burlingtonfabrics.com