Update on Cotton Finishing Innovations
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• TOUGH COTTON™ Technology
  – TOUGH COTTON on Knits
• endure™
• STORM DENIM™ Technology
• WICKING WINDOWS™ Technology
• NATURAL WICK™ Technology
• Antimicrobial
TOUGH COTTON™ Technology
A New Durable Press Finish that makes Woven Fabrics STRONGER LONGER
Definition: TOUGH COTTON™ technology

• A specially engineered finish to improve wear of durable press (DP) cotton garments
  – Improved tensile and tear strength
  – Superior abrasion resistance
    • Improved crease edge abrasion
  – Good hand and drape
  – Wrinkle Resistance
Trial Results – Post-cure Navy Samples

**DP Ratings (AATCC 124) after 3 HLTD**

- No Finish: 1
- Standard DP: 3
- TOUGH COTTON™: 3

**Tensile (lbs) - Fill**

- No Finish: 100
- Standard DP: 60
- TOUGH COTTON™: 40

**Tear (lbs) - Fill**

- No Finish: 4
- Standard DP: 3
- TOUGH COTTON™: 4
Trial Results – Post-cure Navy Samples

* Tested after 3 HLTD
Martindale Abrasion Test
## More Martindale Results

<table>
<thead>
<tr>
<th>No Finish</th>
<th>Standard DP</th>
<th>TOUGH COTTON™</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Sample" /></td>
<td><img src="image2.png" alt="Sample" /></td>
<td><img src="image3.png" alt="Sample" /></td>
</tr>
</tbody>
</table>

- **7,000 cycles**
- **10,000 cycles**
- **15,000 cycles**

Tested on the Nu-Martindale

Post-cure khaki samples
Improved Crease Edge Abrasion

Standard DP Finish

TOUGH COTTON™

Pant legs were laundered 30 times

Post-cure navy pant legs
What’s New About TOUGH COTTON™ Technology?

• Several mills in North America and Asia have successfully run trials

• Major mill adoption in Mexico

• TOUGH COTTON™ components are compatible with stain repel & release
TOUGH COTTON™ Finish for Knits

www.tigerwoods.com

Ladies Ping Golf Shirt

www.tigerwoods.com
Reasons for TOUGH COTTON™ Knits

• Obtain benefits of resin finishing with less negative effects

• Improved burst strength
  • Especially on fabrics treated with cellulase enzyme
  • Cellulase improves appearance and hand, but causes loss in burst strength, especially with resin finish

• Lower cure temperature with TOUGH COTTON finish
Smoothness Rating

3 Home Laundering & Tumble Drying Cycles (HLTD)
**Burst Strength**

Measured on Truburst tester
Formaldehyde Release (ISO 14184-1)

Scoured Only

Control

TOUGH COTTON™
Summary TOUGH COTTON™ Finish On Knits

• Shrinkage reduction and smoothness were similar for TOUGH COTTON and Control finishes

• TOUGH COTTON finish gave improved burst strength

• Lower formaldehyde release with TOUGH COTTON finish
Status of TOUGH COTTON™ Finish On Knits

• Development and testing are continuing at Cotton Incorporated

• Trials have been run successfully in two Asian mills
a new level of performance for cotton home textile products
- Prolongs Product Life
- Reduces Shrinkage (compared to non-treated products)
- Helps Maintain Original Color
- Improves Wrinkle-Resistance
• 75% of consumers rate DURABILITY as a very important purchase factor

• 71% said PRICE was very important

• 67% said COLOR was very important

Source: Cotton Incorporated Home Study and Lifestyle Monitor™ Consumer Attitudinal Research Surveys
Durable Press Rating

AATCC 124
Scale: 1=Worst, 5=Best

- Untreated: 1.0
- Standard DP Finish: 2.3
- Endure™: 3.0
Filling Tensile Strength
ASTM D5034

Lbs. Force to Break

<table>
<thead>
<tr>
<th>Condition</th>
<th>Lbs. Force to Break</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td>102.8</td>
</tr>
<tr>
<td>Standard DP Finish</td>
<td>49.1</td>
</tr>
<tr>
<td>Endure™</td>
<td>56.6</td>
</tr>
</tbody>
</table>
Stoll Flex Abrasion
ASTM D3885-02

352% Improvement Over Standard DP Finish

# Cycles

Untreated: 329
Standard DP Finish: 278
Endure™: 978
Martindale Abrasion Testing

Until complete fabric failure

Standard DP Finish

120,000 cycles

endure™

205,000 cycles
Untreated  Standard DP Finish  endure™

All samples shown were laundered 25 times
Benefits of Using endure™

- Improved Smoothness
- Improved Fabric Strength
- Improved Abrasion Resistance
- Reduced Shrinkage and Shape Retention
- Inhibits Pilling & Fuzzing
- Easier Pressing
- Excellent Hand & Drape
- Durability to At Least 50 Washes
Status of endure™

- Several retailers have shown interest
- Mills in USA and Asia have run successful trials
STORM DENIM™ Technology

- Super repellent, breathable 100% cotton denim
- Protects the wearer from rain, snow, and wet
Super Water Repellency
Super Water Repellency
Super Water Repellency
Breathability
Samples treated with the STORM DENIM™ finish dry in half the time of unfinished denim!

<table>
<thead>
<tr>
<th>Pant legs</th>
<th>Percent (%) Wet Pick-Up, (average of 3 pant legs)</th>
<th>Minutes in Dryer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>After Washer Extract</td>
<td>5</td>
</tr>
<tr>
<td>No Finish</td>
<td>92.8</td>
<td>64.9</td>
</tr>
<tr>
<td>STORM DENIM™ Finish</td>
<td>41.3</td>
<td>18.2</td>
</tr>
</tbody>
</table>

* Feels dry to the touch
Summary of Benefits

Garments treated with STORM DENIM™ Technology:

- Protects the wearer in moderate rain
- Maintains breathability
- Durable to 30 home launderings
- Better strength and more abrasion resistance
- Stain repellent
- Faster drying time (compared to untreated denim)
- Quieter than “noisy” synthetics
- Looks and feels like regular jeans
- Does not interfere with wash down and styling effects → **Fashion!**
STORM DENIM™ Press Release

COTTON INCORPORATED

COTTON INCORPORATED’S STORM DENIM™ TECHNOLOGY

REPELS RAIN, ATTRACTS CONSUMERS

Innovation drives markets. Now, easy, new technologies, new ways of making the
established and familiar more attractive and desirable keep those products viable. The
newly introduced STORM DENIM™ technology provides water repellency, protection
from the cold and damp, and above all, breathability—all in a carrier-free application
that ranges fashion with function like never before.

“Our goal was to offer a high degree of water repellency for use in summer and
outdoor wear, while maintaining the comfort and breathability of cotton,” states William A
Reischl, Cotton Incorporated Director, Textile Chemistry Research.

From a functionality perspective, Reischl and his team achieved their goal. The STORM
DENIM finish compares well to synthetic intersperse water repellency, but retains these
products in breathability. The new finish also provides an additional level of
performance in durability. In tests against unfinished denims of the same weight, the
STORM DENIM finish offered better fill and warp tear resistance, as well as improved
warp flex durability.

Then there is the fashion angle. “In the jeans segment, it’s always about the next new
thing,” says Mark Krentzler, Cotton Incorporated Global Product Supply Chain. “The
industry has seen water repellent denim finishes before, but usually applied in fabric
form, applying in garment form means that almost any denim finish can accept the
technology, creating more consumer benefits, more marketability for specific and none
and with flat, more sales.”

Currently in the U.S., denim accounts for nearly one-third of the apparel market, with
sales representing about 30% of the category. What keeps the blue jean sector drying up as
that market is, there is still room for innovation like the STORM DENIM technology.

Imagine the consumer appeal of a product that can stand up to a variety of activities in
unit and cold conditions, without sacrificing the inherent function of the jean.
STORM DENIM™
Commercial Interest

- 30 Mills, Brands, Apparel, and Retail Companies have shown interest
  - Several are running trials

- PFOA-Free Formulation is available

- Trials have also been performed on twill, corduroy, vamps (i.e. canvas shoes), etc.
WICKING WINDOWS™
Technology
100% Cotton
Moisture Management
WICKING WINDOWS™ Technology

A technique for moving moisture away from the body to the outside of the garment

- Natural rapid wicking
- Lower absorbent capacity
- Faster drying rate
- Reduced fabric cling
Discontinuous print pattern on inside layer next to skin wicks moisture away.

Moisture is pulled through to untreated outside and evaporates.
One-Way Moisture Transfer

Jersey treated with WICKING WINDOWS™ finish after the 10-Drop Test

Face up  Back up
WICKING WINDOWS™ Technology

- Technical details related to WICKING WINDOWS™ Technology have now been published and are publicly available
- 49 Executed CDA’s
- New Technical Bulletin TRI 3020
Moisture Management Testing

- Drop Absorbency (AATCC 79)
- Vertical Wicking
- Horizontal Wicking
- Maximum Absorption (ATS-600)
- Cling Force
- Drying Rate
- 10-Drop Test

Leading the effort to develop an AATCC / ASTM Technical Supplement focused on Moisture Management
Add Comfort to Woven Fabrics with NATURAL WICK™ Technology
Objective: A simple application method to improve certain moisture management properties
- Vertical wicking
- Horizontal wicking
- Drying time

Continuous treatment (Application to entire fabric)
Comparing Two Silicone Softeners: Vertical Wicking

Using a hydrophilic softener can significantly improve wicking

Amino-functional Silicone

Hydrophilic Silicone

100% cotton poplin shirting, mercerized
Comparing Two Silicone Softeners:
Horizontal Wicking

Amino-functional Silicone

Hydrophilic Silicone
NATURAL WICK™ Technology

- Wrinkle-resist resin + catalyst
- Polyethylene softener
- Hydrophilic Silicone softener
- Increased concentration of wetting agent (surfactant)
  - Specific surfactant must be used
26% improvement in wicking before laundering
78% improvement in wicking after 5 launderings
324% improvement in horizontal spread before laundering
238% improvement in horizontal spread after 5 launderings
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