Global Standards for Hand Protection

Jill A Clements
DuPont(TM) Kevlar® Technical Sales Leader,
Mechanical Protection
February 2016
Introduction

Jill Clements is a Senior Research Engineer with DuPont and has 18 years of experience in the development of new products and new applications and currently holds 14 patents. Of those 18 years with DuPont, Jill has been in the Kevlar® business for 15 years and has worked in a variety of market segments including composites, mass transportation, the automotive industry, and high-performance apparel. Jill has presented at numerous trade shows and conferences in North America, Europe, and China and is often seen demonstrating the DuPont Cut Demo Unit. Jill received both her Bachelors and Masters of Science degrees in Mechanical Engineering from The Georgia Institute of Technology.
Global Cut Standards

- The Keys to Cut Resistance
- Background & Comparison of Cut Standards
- Changes to the Cut Standards

The Why
The What
The When
The Keys to Cut Resistance

- Cut resistance is a function of basis weight and material composition.

- Cut resistance can be increased by:
  - Increasing basis weight (14 oz/yd² Kevlar® better than 8 oz/yd² Kevlar®)
  - Using engineered yarns made with stainless steel wire or yarns blended with glass fibers in the core.

Steel or glass in the core.
Considerations for Selection of Cut-Resistant Gloves

- Know your fiber (Kevlar® vs. nylon vs. cotton vs. HPPE)
- Cut Resistance Value (ANSI vs. CE)
- Abrasion Resistance - indicates potential performance in applications
- Overall Glove Construction
  - String knit vs. loop-out terry
  - Coatings/ dots/ leather palms
  - Zonal reinforcements
  - Sizing & fit
Cut Test Methods and Performance Standards
Why Are There Changes?

- Glove performance in the cut-resistant market has improved tremendously in recent years as new yarns and new technologies have been developed.
- Increased granularity is needed within the current level 4 range (1500-3499 grams).
- The goal of moving to a single machine is to reduce the complexity and improve the reliability of the test method.
Cut Test Methods

NO MORE ASTM F1790

ASTM F2992-15
Newly issued 2015 standard for measuring cut resistance of materials
Uses ONLY the TDM-100 machine to measure cut resistance

EN388-2003
European standard to measure cut resistance and other mechanical characteristics
Uses the Coupe Test machine & References ISO 13997

ISO 13997
International Test Standard
Provides a global standard around the TDM-100 machine - will now be used in Europe
Hand Protection Standards

- Standards are used to specify test methods
- Standards usually refer to levels that are achieved by the product tested according to a certain method

ANSI/ISEA 105-16:

ANSI (American National Standards Institute) / ISEA (International Safety Equipment Association) 105 Standard

- US Standard only - is not a government regulation like OSHA
- Indicates the mechanical, thermal, chemical and dexterity requirements, among others
- The final properties are classified by performance levels
- The standard uses a combination of ASTM (American Society for Testing and Materials) and EN (European Norm) methods
What Are The Changes? - ANSI/ISEA 105

- Key area of focus for the changes is the area of cut-resistance testing and classification
- The changes include the use of a single test method - consistent ratings
- There will be an expansion of the classification levels
- Better alignment with similar international standards
- Incorporation of a puncture test for hypodermic needles
## What Are The Changes? - ANSI/ISEA 105

<table>
<thead>
<tr>
<th>Load (grams)</th>
<th>ANSI/ISEA 105-11</th>
<th>ANSI/ISEA 105-16</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 200</td>
<td>0</td>
<td>--</td>
</tr>
<tr>
<td>201 - 499</td>
<td>1</td>
<td>A1</td>
</tr>
<tr>
<td>500 - 999</td>
<td>2</td>
<td>A2</td>
</tr>
<tr>
<td>1000 - 1499</td>
<td>3</td>
<td>A3</td>
</tr>
<tr>
<td>1500 - 3499</td>
<td>4</td>
<td>A4</td>
</tr>
<tr>
<td>&gt; 3500</td>
<td>5</td>
<td>A5</td>
</tr>
<tr>
<td>1500 - 2199</td>
<td></td>
<td>A6</td>
</tr>
<tr>
<td>2200 - 2999</td>
<td></td>
<td>A7</td>
</tr>
<tr>
<td>3000 - 3999</td>
<td></td>
<td>A8</td>
</tr>
<tr>
<td>4000 - 4999</td>
<td></td>
<td>A9</td>
</tr>
<tr>
<td>&gt; 6000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

© 2016 DuPont Confidential for training DuPont personnel and personnel of authorized distributors. These slides & their content cannot be used without the expressed written consent of DuPont.
A new blade is required for each cut.
The blade is moved across the sample once.
The cut resistance is determined by the load required to cut a 20mm reference distance.
EN388 (European Norm)

- Standard referenced throughout the entire EU
- Government regulated
- Gloves are marked with levels with mechanical performance only
- Although a European standard, it is recognized globally
EN 388 Test Equipment

- The blade is re-used
- The cut resistance measured is a ratio of performance of the sample to the performance of a control fabric (cotton canvas)
- ISO 13997 is recommended instead for materials with higher cut performance
What Are The Changes? - EN388

- Most significant change will be in regard to the acceptance of the ISO 13997 (TDM) cut test method (accounts for dulling of blade in Coupe Test)
  - The results will still be reported in Newtons, not grams
  - Levels achieved through the use of the TDM method will be lettered A through F to avoid confusion with the Coupe test method results
- There will be a change of the abrasive paper used
- A new impact protection threshold will be added
### What Are The Changes? - EN388

**Table:**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Level A</th>
<th>Level B</th>
<th>Level C</th>
<th>Level D</th>
<th>Level E</th>
<th>Level F</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TDM Cut Resistance (N)</strong></td>
<td>2</td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>22</td>
<td>30</td>
</tr>
</tbody>
</table>

---

© 2016 DuPont Confidential for training DuPont personnel and personnel of authorized distributors. These slides & their content cannot be used without the expressed written consent of DuPont.
Coupe method cannot be used interchangeably with ASTM & ISO

EN 388 Coupe Method

ANSI/ISEA 105-16 & ISO 13997
Cut Resistance of Typical Gloves using TDM-100

Kevlar® fiber has the highest cut resistance

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
<th>Cut Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% Kevlar® (20oz)</td>
<td></td>
<td>1,230</td>
</tr>
<tr>
<td>100% Dyneema® (20oz)</td>
<td></td>
<td>1,020</td>
</tr>
<tr>
<td>100% Kevlar® (14oz)</td>
<td></td>
<td>925</td>
</tr>
<tr>
<td>Cotton (26oz)</td>
<td></td>
<td>410</td>
</tr>
<tr>
<td>Leather (36oz)</td>
<td></td>
<td>360</td>
</tr>
</tbody>
</table>

© 2016 DuPont Confidential for training DuPont personnel and personnel of authorized distributors. These slides & their content cannot be used without the expressed written consent of DuPont.
Changes primarily focus on cut performance classification in both North America and Europe as both standards move to the same equipment.

<table>
<thead>
<tr>
<th>Classification Levels</th>
<th>NEW ANSI/ISEA 105-16</th>
<th>NEW EN388</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Levels 1 - 9</td>
<td>Cut Index</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Cut Force</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A - F</td>
</tr>
<tr>
<td>Cut Force Achieved</td>
<td>200 - &gt;6000 grams</td>
<td>2 - &gt;30 Newtons</td>
</tr>
<tr>
<td>Hypodermic Needle Test</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Government Regulated</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
What It All Means

- Global alignment around one piece of equipment (TDM) for conducting cut testing will reduce confusion in the market around glove performance.

- Once both NA & Europe are both using the TDM-100 machine, there will be a realignment of glove performance claims - specifically regarding the EN 388 standard.

- North America remains an unregulated market - manufacturers are still not required to label products or even adopt the new standards.

- DuPont is currently conducting multiple tests to better understand how glove performance classification will change specific to the EN388 standard - stay tuned!
This information corresponds to our current knowledge on the subject and may be subject to revision as new knowledge becomes available. It is your responsibility to investigate other sources of information on this issue that more appropriately addresses your product and its intended use. This information is not intended for use by you or others in advertising, promotion, publication or any other commercial use. DUPONT MAKES NO WARRANTIES OF ANY KIND REGARDING THIS INFORMATION AND ASSUMES NO LIABILITY WHATSOEVER IN CONNECTION WITH ANY USE OF THIS INFORMATION. This information is not a license to operate under, or intended to suggest infringement of, any existing trademarks or patents.

Copyright © 2016 DuPont. All rights reserved. The DuPont Oval Logo, DuPont™, The miracles of science™, Kevlar®, Nomex® and SafeSPEC™ are registered trademarks or trademarks of E. I. du Pont de Nemours and Company or its affiliates.