Global Standards for Hand Protection

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November 2015
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Jill Conley is a Senior Research Engineer with DuPont and has 17 years of experience in the development of new products and new applications and currently holds 14 patents. Of those 17 years with DuPont, Ms. Conley has been in the Kevlar® business for 14 years and has worked in a variety of market segments including composites, mass transportation, the automotive industry, and high-performance apparel. She also manages the Cut-Performance Lab within DuPont. Ms. Conley has presented at numerous tradeshows and conferences in North America, Europe, and China and is often seen supporting the DuPont Cut Demo Unit. Ms. Conley 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

Additional Test Methods in the Standards

Changes to Cut Standards
  The Why
  The What
  The When
The Keys to Cut Resistance

• Cut resistance is a function of basis weight and material composition
• Increased cut protection performance can be achieved by:
  ▪ Increasing basis weight (14 oz/yd² better than 8 oz/yd²)
  ▪ Using high performance materials (Kevlar® vs. cotton, leather)
  ▪ Using Engineered Yarns made with stainless steel wire or blended
    yarns of fiberglass and high-performance textiles or other synthetic
    materials
• The cut resistance of a glove can also be influenced by:
  ▪ Fabric construction (knit, woven, nonwoven)
  ▪ Coatings
  ▪ Contaminants, etc.
Considerations for Selection of Cut-Resistant Gloves

Know your fiber

The Basis Weight of the glove material (oz/yd²)

Total Glove Weight by size – this is a secondary measure to basis weight and can give an indication of the amount of coating on a glove

Cut Resistance Value (ANSI vs. CE vs. ISO)

Abrasion Resistance

Overall Glove Construction
- String knit vs. loop-out terry
- Coatings/ dots/ leather palms
- Zonal reinforcements
- Sizing & fit
Cut Test Methods and Performance Standards
**Cut Test Methods**

**ASTM F1790-97**
The original standard test method for measuring cut resistance of materials using the CPPT machine
Used to specify ANSI/ISEA cut levels

**ASTM F1790-05**
The 2005 revision to the original standard
Uses 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

**ISO 13997**
International Test Standard
Attempted to provide a global standard around the TDM-100 machine
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** (American National Standards Institute / **ISEA** (International Safety Equipment Association) **105** Standard

- US Standard only – is not a government regulation
- 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
ANSI/ISEA 105 Test Methods to Determine Cut Resistance

ASTM F1790-97 & ASTM F1790-05

There are multiple testers allowed: CPPT & TDM

Calibration: the reference load and distances are different

Specimen Mounting

Reference cut distance of 25mm vs. 20mm

1997 Method - CPPT  similiar  2005 Method - TDM

Not comparable

Not comparable
EN388 (European Norm)

Standard referenced throughout the entire EU

Government regulated

Gloves are marked with levels, currently mechanical performance only

Although a European standard, it is recognized globally
ANSI/ISEA 105 vs. EN388

The levels are not interchangeable between the two standards

Performance at the same “level” is not measured in the same way or on the same type of equipment

<table>
<thead>
<tr>
<th>ANSI/ISEA 105</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut grams</td>
<td>&lt; 200</td>
<td>≥ 200</td>
<td>&gt; 500</td>
<td>&gt; 1000</td>
<td>&gt; 1500</td>
<td>&gt; 3500</td>
<td>-</td>
</tr>
<tr>
<td>Abrasion cycles/0.5 kg</td>
<td>&lt; 100</td>
<td>≥ 100</td>
<td>&gt; 500</td>
<td>&gt; 1000</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Abrasion cycles/1.0 kg</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&gt; 3000</td>
<td>&gt; 10000</td>
<td>&gt; 20000</td>
</tr>
<tr>
<td>Puncture N</td>
<td>&lt; 10</td>
<td>≥ 10</td>
<td>≥ 20</td>
<td>≥ 60</td>
<td>≥ 100</td>
<td>≥ 150</td>
<td>-</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EN388</th>
<th>Level 0</th>
<th>Level 1</th>
<th>Level 2</th>
<th>Level 3</th>
<th>Level 4</th>
<th>Level 5</th>
<th>Level 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut index</td>
<td>-</td>
<td>≥ 1.2</td>
<td>≥ 2.5</td>
<td>&gt; 5.0</td>
<td>&gt; 10.0</td>
<td>&gt; 20.0</td>
<td>-</td>
</tr>
<tr>
<td>Cut N</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&gt; 13</td>
<td>&gt; 22</td>
<td>-</td>
</tr>
<tr>
<td>Abrasion cycles</td>
<td>-</td>
<td>≥ 100</td>
<td>≥ 500</td>
<td>≥ 2000</td>
<td>≥ 8000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Puncture N</td>
<td>-</td>
<td>≥ 20</td>
<td>≥ 60</td>
<td>≥ 100</td>
<td>≥ 150</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
Test methods cannot be used interchangeably

Cut Resistance Testing

ASTM F1790 (US)
ISO 13997 (US, International)
EN 388 (International)

ANSI / ISEA 105
EN 388
EN 388

Three cut test methods, three cut testers
A new blade is required for each cut
- The cut resistance measured is load vs. a reference distance
- Values are scaled based on the blades performance with a control both before and after test (neoprene)
EN388 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 articles higher than level 4
ANSI Cut Level 4 vs. CE Level 4

- The cut test methods are not the same
- The cut performance standards are not the same
- The equipment used to perform the tests are not the same
- ANSI Cut Level 4 and CE Level 4 are not the same

- Cut Levels are only the same if everything is equal
Global Recognition of Cut Standards
Additional Test Methods in the Standards
North American Standard – Thermal Resistance

ASTM F1060: Standard Test Method for Thermal Protective Performance of Materials for Protective Clothing for Hot Surface Contact

Measures conductive heat resistance, which indicates the thermal insulation properties for contact with hot surfaces

<table>
<thead>
<tr>
<th>Level</th>
<th>Highest contact temperature (°C) at which both time-to-2nd degree burn ≥ 15 seconds and alarm time ≥ 4 seconds</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&lt; 80</td>
</tr>
<tr>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>140</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
</tr>
<tr>
<td>4</td>
<td>260</td>
</tr>
<tr>
<td>5</td>
<td>320</td>
</tr>
</tbody>
</table>
North American Standard – Thermal Resistance
North American Standard – Abrasion Resistance

**ASTM D3389:** Standard Test Method for Coated Fabrics Abrasion Resistance

Measures the number of cycles to wear through the coating (first sign of fabric) using the Taber Rotary Platform, Double-Head Method

<table>
<thead>
<tr>
<th>Level (tested at 500 gram load)</th>
<th>Abrasion cycles to fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>&lt; 100</td>
</tr>
<tr>
<td>1</td>
<td>≥ 100</td>
</tr>
<tr>
<td>2</td>
<td>≥ 500</td>
</tr>
<tr>
<td>3</td>
<td>≥ 1000</td>
</tr>
</tbody>
</table>

**ASTM D3884:** Standard Guide for Abrasion Resistance of Textile Fabrics

Measures the number of cycles to wear through the fabric (first thread or yarn is broken) using the Taber Rotary Platform, Double-Head Method

<table>
<thead>
<tr>
<th>Level (tested at 1000 gram load)</th>
<th>Abrasion cycles to fail</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>≥ 3000</td>
</tr>
<tr>
<td>5</td>
<td>≥ 10000</td>
</tr>
<tr>
<td>6</td>
<td>≥ 20000</td>
</tr>
</tbody>
</table>
North American Standard – Abrasion Resistance

The test fabric is continuously rubbed against the abrasive material until failure.
Proposed Changes to the Global Cut Standards

The Why

The What

The When
Why Are There Proposed Changes – ANSI/ISEA

- Updates to the ANSI/ISEA 105 standard have been proposed in order to reflect new and current technologies in both yarn and glove design and new applications requiring glove use.

- The proposed updates would also harmonize the criteria with international standards in use in other countries.

- As stated on the International Safety Equipment Association (ISEA) website, the ISEA committee is currently seeking public comment on the draft revisions to its voluntary standard for hand protection selection.

The draft revision available for public comment can be found at: https://safetyequipment.org/isea-announces-public-review-for-high-visibility-apparel-hand-protection-selection-standards/
What Are The Proposed Changes – ANSI/ISEA

• Key area of focus for the proposed changes is the area of cut-resistance testing and classification

• Proposed changes include the use of a single test method - consistent ratings

• Proposed expansion of the classification levels

• Better alignment with similar international standards

• Incorporation of a needlestick puncture test

ISEA must receive public comments by November 23, 2015. Send requests for copies to isea@safetyequipment.org. The cost for public review copies is $35 for ANSI/ISEA 105. Contact the ISEA at 703-525-1695 for additional questions.

1 isea@safetyequipment.org
Why Are There Proposed Changes – EN388

- In need of revision due to some issues of reproducibility specific to the cut and abrasion parts of the standard
- Recognition of the ISO 13997 TDM test as a more reliable test method than the Coupe test because of the issue of blade dulling with the Coupe test
- Coupe test method has been maintained at this time to ensure continuity of information in the near future
- Intent is that at the next revision cycle, which is every five years, the Coupe test will probably be removed
- A test for impact protection has also been added to the standard
What Are The Proposed Changes – EN388

• Most significant change will be in regard to the acceptance of the ISO 13997 (TDM) cut test method
  • The 6 lower cut levels will be aligned to the ANSI/ISEA 105 method
  • 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
• The Coupe test will also be amended to take into account the dulling of the blade
• There will be a change of the abrasive paper used
• A new impact protection threshold will be added
What Are the Proposed Changes?

prEN388

Example of marking for the mechanical risks: FprEN 388

<table>
<thead>
<tr>
<th>Risk</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact protection</td>
<td>Achieved</td>
</tr>
<tr>
<td>Cut (TDM Test)</td>
<td>Level E</td>
</tr>
<tr>
<td>Puncture (N)</td>
<td>Level 3</td>
</tr>
<tr>
<td>Tear (N)</td>
<td>Level 4</td>
</tr>
<tr>
<td>Cut (Coupe Test)</td>
<td>Level 4</td>
</tr>
<tr>
<td>Abrasion (cycles)</td>
<td>Level 3</td>
</tr>
</tbody>
</table>

Example: 3443EP
When Would the Proposed Changes Happen?

ANSI/ISEA 105
• Proposed changes to the standard are currently out for review, and the standard is still subject to further changes
• The final changes are pending acceptance with the December committee meeting and, if accepted, would become official with the 2016 standard revision

EN388
• Proposed EN388 changes have already gone through a series of votes
• The committee has approved the draft to allow a final ballot to take place sometime during the fourth quarter of 2015
• The new standard would become effective in late 2015 or early 2016
• Changes would apply only to the EU until the new standard has been adopted or transposed in other countries
What It All Means

• EN388 has made several changes that will reduce the variability of the testing, give more alignment with the ANSI/ISEA method and eventually eliminate the effect of blade dulling in the Coupe test

• The purpose of global alignment around one piece of equipment (TDM) for conducting cut testing is to reduce or eliminate confusion in the market around glove performance

• These changes will present many opportunities for education in the marketplace

• Most importantly, increased granularity of cut levels and better reproducibility will allow for continued innovation at both the glove and yarn level
Questions
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