Using ANSI/ISEA 105 for Selecting Appropriate Hand Protection: A Review of Specific Requirements

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Presentation Topics

• Review of Performance Areas
  – Description of test methods
  – Classification of performance
  – How test results can be used

• Comparison of ANSI/ISEA 105 with European standards

• Examples for Using ANSI/ISEA 105
Glove Performance Areas

- Mechanical Protection
- Chemical Protection
- Heat and Flame Protection
- Protection from Cold
- Protection from Vibration \((proposed)\)
- Hand Function – Dexterity \((proposed)\)
# Glove Performance Classification

## Chemical Permeation Resistance

<table>
<thead>
<tr>
<th>Breakthrough Time (minutes)</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;480</td>
<td>6</td>
</tr>
<tr>
<td>&gt;240</td>
<td>5</td>
</tr>
<tr>
<td>&gt;120</td>
<td>4</td>
</tr>
<tr>
<td>&gt;60</td>
<td>3</td>
</tr>
<tr>
<td>&gt;30</td>
<td>2</td>
</tr>
<tr>
<td>&gt;10</td>
<td>1</td>
</tr>
</tbody>
</table>
Mechanical Protection

- Evaluates glove materials for resistance to physical hazards
- Test properties:
  - Cut resistance
  - Puncture resistance
  - Abrasion resistance
Cut Resistance

- **Test Method** – ASTM F 1790
- **Procedure** – Measures distance of blade travel across specimen until “cut through”
- **End Point** – Weight needed for 25 mm of blade travel
- **Classifications** – 5 levels
Puncture Resistance

- **Test Method** – EN 388
- **Procedure** – Specimen clamped in holder, nail-like puncture probe pushed through specimen
- **End Point** – Force to cause puncture
- **Classifications** – 5 levels
Abrasion Resistance

- **Test Method** – ASTM D 3389
- **Procedure** – Glove material specimen placed on turntable; specimen rotated under weighted abrasive wheels
- **End point** – Cycles to hole through film or coating
- **Classifications** – 6 levels (3 at 500 g load; 3 at 1000 g load)
Chemical Protection

- Evaluates barrier characteristics of gloves and glove materials:

- Test properties:
  - Chemical permeation resistance
  - Chemical degradation resistance
  - Detection of holes
Chemical Permeation Process

Solvent
Permeant

Solution

Polymer Membrane

Diffusion

Evaporation
Chemical Permeation Resistance

- **Test Method** – ASTM F 739
- **Procedure** – Specimen divides test cell into 2 halves; one side contacted with chemical; other side samples for permeating chemical
- **End Point** – Breakthrough time
- **Classifications** – 6 levels
Permeation Test System

Collection medium in (to analyzer)

Test chemical

Collection medium out

Material
Interpretation of Permeation Tests

- Some permeation does occur prior to breakthrough time
- Interpretation is standardized by using normalized breakthrough time
Chemical Degradation Process

• Definition
  – Change in a materials physical properties are a result of chemical exposure

• Test Approaches
  – ASTM D471 (rubber)
  – ASTM D543 (plastics)
  – ANSI/ISEA 105 (gloves)
Chemical Degradation Resistance

- **Test Method** – Section 6
- **Procedure** – Specimen contacted with chemical on 1 side; puncture resistance measured before and after exposure
- **End Point** – Percent change in puncture resistance
- **Classifications** – 4 levels
# Standard Test Chemicals

<table>
<thead>
<tr>
<th>Liquids</th>
<th>Gases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>Ammonia</td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>1,3-Butadiene</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>Chlorine</td>
</tr>
<tr>
<td>Dichloromethane</td>
<td>Ethylene Oxide</td>
</tr>
<tr>
<td>Diethylamine</td>
<td>Hydrogen Chloride</td>
</tr>
<tr>
<td>Dimethylformamide</td>
<td>Methyl Chloride</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
<td>ASTM F 1001 Chemicals</td>
</tr>
<tr>
<td>Hexane</td>
<td></td>
</tr>
<tr>
<td>Methanol</td>
<td></td>
</tr>
<tr>
<td>Nitrobenzene</td>
<td></td>
</tr>
<tr>
<td>Sodium Hydroxide (50%)</td>
<td></td>
</tr>
<tr>
<td>Sulfuric Acid (95%)</td>
<td></td>
</tr>
<tr>
<td>Tetrahydrofuran</td>
<td></td>
</tr>
<tr>
<td>Tetrachloroethylene</td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td></td>
</tr>
</tbody>
</table>
Detection of Holes

• **Test Method** – ASTM D 5151

• **Procedure** – Glove suspended and filled with 1000 mL of water; inspected after 2 minutes for leakage

• **End Point** – AQL for failure rate

• **Classifications** – 1 Level (minimum AQL of 2.5)
Heat and Flame Protection

- Evaluates glove material performance in protecting hands from heat and flame
- Properties measured:
  - Flame resistance
  - Heat degradation resistance
  - Conductive heat resistance
Flame Resistance

- **Test Method** – ASTM F 1358
- **Procedure** – Glove specimen materials suspended in flame for 3 and 12 seconds; time of continued burning and burn damage measured
- **End Point** – Afterflame time, burn distance
- **Classifications** – 4 levels
Heat Degradation Resistance

• **Test Method** - ISO 17493

• **Procedure** – Glove filled with vermiculite, set in oven at specified temperature for 5 minutes; shrinkage measured; heat behavior noted

• **End Point** – Highest temperature with no damage; <5% pct. shrinkage

• **Classification** – 5 levels
Conductive Heat Resistance

- **Test Method** – ASTM F 1060
- **Procedure** – Glove material placed on hot plate at specified temperature; calorimeter measures rate of heat transfer
- **End Point** – Highest temperature with time to burn $> 15$ s; Time to pain $> 4$ s
- **Classifications** – 5 levels
Prediction of Burn Injury

Absorbed Total Energy at Skin (cal/cm²s) vs. Tolerance Time (seconds)

The graph shows the relationship between the absorbed total energy at the skin (cal/cm²s) and the tolerance time (seconds). The data is represented by three different curves, each indicating a different tolerance level.
**Protection from Cold**

- **Test Method** – ISO 5085-1 (cold conductive resistance)
- **Procedure** – Material placed on heated plate in cold environment; energy measured for keeping plate at uniform temperature
- **End Point** – Thermal resistance (heat transfer coefficient)
- **Classifications** – 4 levels
CEN Glove Standards

- EN 374 - Chemicals/microorganisms
- EN 388 - Mechanical risks
- EN 407 - Thermal risks
- EN 420 - General requirements
- EN 421 - Radioactive risks
- EN 511 - Cold
- EN 1082 - Cuts and stabs
Comparison with CEN Standards

- Some tests are identical with the same classification ratings
  - Puncture resistance, cold conductive resistance
- Some tests are identical but different classes are used
  - Permeation resistance, detection of holes
- Some tests and classification systems are completely different
  - Abrasion resistance, heat/flame resistance test
Example ANSI/ISEA 105 Application

- Specific application involving single toxic chemical with physical hazards and possible flame contact

<table>
<thead>
<tr>
<th>Glove</th>
<th>Permeation Class</th>
<th>Cut Resistance</th>
<th>Puncture Resistance</th>
<th>Flame Resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>60 min (3)</td>
<td>550 g (2)</td>
<td>45 N (2)</td>
<td>&lt;3 sec (0)</td>
</tr>
<tr>
<td>B</td>
<td>45 min (2)</td>
<td>400 g (1)</td>
<td>20 N (2)</td>
<td>&lt;12 sec (2)</td>
</tr>
<tr>
<td>C</td>
<td>90 min (3)</td>
<td>350 g (1)</td>
<td>15 N (1)</td>
<td>No ignition (4)</td>
</tr>
</tbody>
</table>
Summary

- ANSI/ISEA 105 provides broad range of properties for evaluating glove performance against different hazards
- Use of standardized test methods allow end users to easily compare gloves
- System of classifying performance assists in determining significant differences between glove products