Do I Need Dual Hazard Protection?

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Do I Need Dual Hazard Protection?

Webinar Overview

- Introduction – Hazard Risk Types

- Contrast Short Duration Fire and Arc Flash
  - Hazard Characteristics
  - Industry Standards and Test Methods
  - Garment Performance

- Conclusions and Summation

- Questions and Answers
Introduction
Do I Need Dual Hazard Protection?

Introduction – Hazard Risk Types

Is Your Primary Hazard Fire? – Short Duration Fires

- Flash - Rapid Burning of Vapor Cloud
- Jet - Burning of Pressurized Fuel Supply
- Pool - Burning of Flammable Liquid Spill
- BLEVE - Explosion & Fireball from Catastrophic Failure of Contained Liquid

- Can Ignite / Melt Typical Work Clothing
- Burn Unprotected Skin

Which Type of Fire Hazard Do You Have?

Fuel Sources

- Flammable Liquids
- Flammable Gases
- Combustible Dusts
Are Your Primary Hazard Electrical? – Arc Flash

- Physical arc is created when electricity conducts unpredictably between exposed phases or to ground
- Arc Flash can occur in low voltage (LV) and high voltage (HV) electrical systems
- Arc flash events can be caused by:
  - Human error or improper training
  - Poorly maintained equipment
  - Equipment failure
  - Poorly designed electrical systems

✓ Can Ignite / Melt Typical Work Clothing
✓ Burn Unprotected Skin

Are The Majority of Your Workers Exposed to Arc Flash Risks?
Do I Need Dual Hazard Protection?

Introduction – Hazard Risk Types

Do You Have A True Dual Hazard Risk?

- Full understanding of the true hazard risk is imperative
- Short duration fires and arc flash events pose different hazards
- Proper worker PPE (Personal Protective Equipment) must match recognized hazards
- Risk of any hazard event is specific to the individual organization, location, process, equipment, etc.
- Necessity for self-analysis of hazard and risk analysis
- Easy decision may not give the best protection for your specific hazard risk
- True Dual Hazard Risk – Worker exposed to both hazards

**MYTH**

Higher Arc Flash Rating Equals Increased Fire Protection
Do I Need Dual Hazard Protection?

Introduction – Hazard Risk Types

OSHA Regulations to Industrial Standards and Test Methods

Key U.S. Government Regulations (OSHA)
- U.S. Code, Title 29 Chapter 15 § 654 (General Duty)
- 29 CFR 1910.132 (PPE General Requirements)

Industry Standards and Test Methods – Tools to comply with OSHA
- **Fire**
  - NFPA 2112 (CGSB 155.20)  
  - ASTM F 1930
  - NFPA 2113 (CGSB 155.21)

- **Electric Arc**
  - NFPA 70E  
  - ASTM F 1506
  - NESC  
  - ASTM F 1959
Do I Need Dual Hazard Protection?

Introduction – Hazard Risk Types

Overview – Industry Standards
Do I Need Dual Hazard Protection?

Overview – Industry Standards

**NFPA 2113:** Selection, Care, Use, and Maintenance of Flame-Resistant Garments for Protection of Industrial Personnel Against Short-Duration Thermal Exposures From Fire.

- **Standard Primarily for End-Users**
- OSHA Recognized Tool for 29 CFR 1910.132
- Perform Fire / Exposure Hazard Analysis
- Protective Clothing Selection
  - Meet Minimum NFPA 2112 Specifications
  - Meet Required Protection Identified in Hazard Analysis
    - Based on Specific Work Tasks
- Wearing / Training Information
- Care & Maintenance Information
- Neck, Face, Head, Hand & Foot Coverings PPE

Have You Performed a Comprehensive Fire Hazard and Risk Analysis?
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Overview – Industry Standards

**NFPA 2112:** Standard on Flame Resistant Garments for Protection of Industrial Personnel Against Flash Fire

- **Standard Primarily for Manufacturers**, not End-Users
- Provides **Minimum** Requirements for Design, Construction, Evaluation, and Certification of FR Garments
- Qualified Garment must exhibit 50% or Less Total Predicted Burn Injury (TPBI)
- Required Tests (3rd Party Certified)
  - **Instrumented Thermal Manikin (ASTM F 1930)**
  - Vertical Flammability (New and 100x IL)
  - Heat Transfer Performance (HTP)
  - Thermal Shrinkage Resistance
  - Heat Resistance
  - Sewing Thread Melting
Chances of surviving a fire decrease...

• Burn Injury
• Age

Source: American Burn Association 2011 study
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Overview – Industry Standards

NFPA 70E: Standard For Electrical Safety In the Workplace

- Standard encompasses guidance for making hazard identification and risk assessments
- PPE and Clothing Selection
- Assists in complying with OSHA 1910 Subpart S and OSHA 1926 Subpart K
- Establishes Arc flash boundaries
- Establishes Arc flash PPE categories
  - Arc PPE categories range from 1 to 4.
  - Arc PPE category is used to determine the necessary arc rating of a garment for a specific job task
**Do I Need Dual Hazard Protection?**

**Arc Flash Protection Boundary**

- **Calculated for Each Task**
  - **Outside** 2nd Degree Burn
    - Injury Not Expected
    - FR PPE Not Required
    - \( \text{Burn Injury Can Occur} \)
  - **Inside** 2nd+ Degree Burn
    - Injury Predicted
    - FR PPE Required

- **PPE Needs May Differ For Body Parts**
  - \( \text{Arms & Hands} \)

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Overview – Industry Standards

NFPA 70E – Methods for Arc Flash Clothing Selection

Method A [Section 130.5(C)(1) and Annex D, H]:

- Incident energy analysis method

Method B [Section 130.7(C)(15)(A)(b) and 130.7(C)(16)]:

- Arc flash PPE categories method

<table>
<thead>
<tr>
<th>Arc PPE Category</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Arc Rating (cal/cm²)</td>
<td>4</td>
<td>8</td>
<td>25</td>
<td>40</td>
</tr>
</tbody>
</table>

Category 1

Category 4
Do I Need Dual Hazard Protection?

Introduction – Hazard Risk Types

Overview – Test Methods
Do I Need Dual Hazard Protection?

Overview – Test Methods

Primary Standard Test Methods

Fire ASTM F-1930

- Used to Certify fabrics in NFPA 2112
  - Pass / Fail Assessment (6 cal/cm² Exposure)
- ASTM Coverall Pattern Evaluated
- Average of 3 Exposures
- Sensors Measure Transmitted Heat
  - Variable Acquisition Period (ca. ≤ 120 s)
  - Predicted Burn Injury & Probability of Survival
- Jet Fire Exposure
  - 2 cal/cm²s Heat Flux & Variable Duration

Electric Arc Flash ASTM F-1959

- Determine Arc Rating of FR System
- Specimens Tested On Flat Panels
- Minimum 20 Panels Test
- Sensors Measure Heat from Arc
  - Incident Energy of Arc
  - Energy Transmitted Through Specimen
- Fixed Fault Current (8 kA) with Adjustable Duration
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Overview – Test Methods

Fire - THERMAL MANIKIN TEST (ASTM F 1930)

- Developed by U.S. Military and DuPont
- Used to Certify Fabrics in NFPA 2112
  - Pass / Fail Assessment (6 cal/cm² Exposure)
  - Total Predicted Burn Injury (TPBI) must fall below 50%
- Average of 3 Exposures
- Sensors Measure Transmitted Heat
  - Collects data for 60 seconds (@ 10 times a second)
  - Predicted Burn Injury & Probability of Survival
- Jet Fire Exposure
  - Variable Duration & Heat Flux
- Three Commercial Facilities in N.A.
**Do I Need Dual Hazard Protection?**

**Overview Test Methods**

**Fire - THERMAL MANIKIN TEST (ASTM F 1930)**

- **Nomex® IIIA**
- **Untreated Cotton/Poly**
- **Untreated Cotton**

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**Do You Know What Your Workers Are Wearing?**
Do I Need Dual Hazard Protection?

Overview – Test Methods

Industry misconceptions may influence FR clothing selection

The purpose of flame resistant clothing is to only protect workers from "Flash Fire" hazards.

All, or most, "Flash Fire" hazards:
- Are "Short Duration" (3 seconds or less)
- Have the "Same Intensity" (2 cal/cm²s)

Intensity Matters

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Question: WHAT ARE TYPICAL INDUSTRIAL FIRES?

Answer: THERE ARE NO TYPICAL INDUSTRIAL FIRES.

Three (3) Main Variables (Duration X Intensity = Magnitude)

- Duration (Exposure Time, seconds) - 1 sec to “Time to Escape”
- Intensity (Heat Flux) - <1 to >7 cal/cm²s”
- Magnitude (Total Exposure Energy) - <1 to >20 cal/cm²

It is the employer’s responsibility to assess the hazard and identify appropriate FR clothing to protect the workers

- Reference: OSHA 29 CFR 1910.32

Select PPE that will provide a level of protection greater than the minimum required to protect employees from hazards.

- Reference: OSHA 3151-12R 2003

Question: Have You Fully Assessed Your Exposure to Fire Risk?
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Overview - Test Methods

ASTM F-1959 – Arc Flash Test Method

- Determine Arc Rating (cal/cm^2) of FR System
  - The Energy Level predicting a 2nd Degree Burn Occurring. Referred to as Arc Thermal Performance Value (ATPV) or the Energy Level to Break-open The Fabric(s) (Ebt)

- Specimens Tested On Flat Panels
- Minimum 20 Panels Test
- Sensors Measure Heat from Arc
  - Incident Energy of Arc

**ARC rating (cal/cm^2):** The Energy Level With 50% Probability of 2nd Degree Burn Occurring *(Referred to as Arc Thermal Performance Value (ATPV)) or The Energy Level to Break-open The Fabric(s) (Ebt)*
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Overview – Test Methods

Non-FR Fabrics Can Ignite and Burn and Melt When Exposed to An Electric Arc

Examples:
Cotton
Wool
Polypropylene
Polyester
Nylon

Do You Know What Your Workers Are Wearing?
THREATS INSIDE THE ARC FLASH PROTECTION BOUNDARY

An arc event presents many types of hazards

- Intense Radiant Energy > 1.5 cal/cm²
  - 2nd & 3rd Degree Burns for Unprotected Skin
  - Minimum Ignition Energy for non-FR Clothing
- Typically Lasts Less Than 1 Second
- Molten Metal Splatter / Hot Gases / Smoke
- Secondary Fire (Transformer Oils ..)
- Battery Acids
- Potential Concussive Forces / Projectiles
- Damaging Sound Pressure Level
Do I Need Dual Hazard Protection?

Introduction – Hazard Risk Types

Differentiation – Hazard Risk Types
## Do I Need Dual Hazard Protection?

### Differentiation – Hazard Risk Types

#### Quick Summary

<table>
<thead>
<tr>
<th>Hazards</th>
<th>Key End-Users</th>
<th>Exposures</th>
<th>Temp Limits</th>
<th>Exposure Time</th>
<th>Key Performance / Attribute Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fire</td>
<td>Industrial Workers</td>
<td>Convective Energy Exposure Time Smoke / Fumes Re-Ignition Potential</td>
<td>~1000 °C</td>
<td>Seconds</td>
<td>NFPA 2112 / 2113</td>
</tr>
<tr>
<td>Arc</td>
<td>Electricians Utility Workers</td>
<td>High Radiant Energy Concussive Forces Smoke / Fumes Molten Metal Splatter</td>
<td>~6000 °C</td>
<td>&lt;&lt; 1 sec</td>
<td>NFPA 70E / NESC</td>
</tr>
</tbody>
</table>

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Differentiation – Hazard Risk Types

## Quick Summary

<table>
<thead>
<tr>
<th>NFPA 2112 - ASTM F-1930</th>
<th>NFPA 70e – ASTM F-1959</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finished Garment Subjected to ‘Jet’ Fire – Engulfment Fireball</td>
<td>Fabric Sample Subjected to Arc Flash</td>
</tr>
<tr>
<td>2 cal/cm²s Heat Flux at 3 seconds duration 6 cal/cm² total Energy Exposure</td>
<td>&lt; 1 second Arc of Intense Energy &gt; 1.5 cal/cm²</td>
</tr>
<tr>
<td>Garment Must Not Exhibit &gt; 50% TPBI</td>
<td>Energy that results in second degree burns or break open</td>
</tr>
<tr>
<td></td>
<td>Does Not Predict a TPBI</td>
</tr>
</tbody>
</table>
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Introduction – Hazard Risk Types

Actual Garment Evaluations
Garment Evaluations

**DuPont™ Thermo-Man® System**

3 Second Exposure Comparison

**Nomex® IIIA 6.0 oz/yd²**

and

**88/12 FR Treated Cotton / Nylon 7.0 oz/yd²**

Exposure: 6 cal/cm² [Time: 3 s  Heat Flux: 2 cal/cm²s]

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**NOMEX® IIIA, 6 oz/yd²**
- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- Predicted Burn Injury: 10.7%

**88/12 FR Treated Cotton / Nylon, 7 oz/yd²**
- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- Predicted Burn Injury: 15.6%
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**NOMEX® IIIA, 6 oz/yd²**
- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- Predicted Burn Injury: 10.7%

**88/12 FR Treated Cotton Nylon, 7 oz/yd²**
- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- Predicted Burn Injury: 15.6%
Garment Evaluations

DuPont™ Thermo-Man® System
4 Second Exposure Comparison

Nomex® IIIA 6.0 oz/yd²
and
88/12 FR Treated Cotton / Nylon 7.0 oz/yd²

Exposure: 8 cal/cm² [Time: 4 s  Heat Flux: 2 cal/cm²s]

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**NOMEX® IIIA, 6 oz/yd²**
- 4 seconds @ 2.0 cal/cm²s
- Total Exposure: 8.0 cal/cm²
- Predicted Burn Injury: 34.4%

**88/12 FR Treated Cotton / Nylon, 7 oz/yd²**
- 4 seconds @ 2.0 cal/cm²s
- Total Exposure: 8.0 cal/cm²
- Predicted Burn Injury: 69.7%
**Do I Need Dual Hazard Protection?**

**NOMEX® IIIA, 6 oz/yd²**
- 4 seconds @ 2.0 cal/cm²s
- Total Exposure: 8.0 cal/cm²
- **Predicted Burn Injury: 34.4%**

**88/12 FR Treated Cotton / Nylon, 7 oz/yd²**
- 4 seconds @ 2.0 cal/cm²s
- Total Exposure: 8.0 cal/cm²
- **Predicted Burn Injury: 69.7%**
Do I Need Dual Hazard Protection?

Garment Evaluations

Thermo-Man® ASTM F-1930 Comparison

![Bar chart showing TPBI% for different materials and PPE categories.]

- **Nomex® IIIA 6 oz**: 10.70% TPBI, PPE Category 1
- **88/12 FRT Cotton Nylon 7 oz**: 34.40% TPBI, PPE Category 2
- **ASTM F-1930 2.0 Cal/cm² - 3s**: 15.60% TPBI
- **ASTM F-1930 2.0 Cal/cm² - 4s**: 69.70% TPBI

**Arc Flash**

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Garment Evaluations

Is Your Current PPE Program The BEST Fit For Your Risk Assessment?

- Are your current PPE choices the BEST fit for your risk assessment?
- There are true Dual Hazard Protection PPE choices
- Engineered blends available that demonstrate protection for both hazard types.
- Chose the solution that best fits your assessment needs
- Cannot Infer short duration fire performance based on ATPV or electrical arc categories, and vice versa
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Summation
Do I Need Dual Hazard Protection?

Summation - Takeaways

- Have You Fully Assessed Your Hazard Risks?
  - NFPA 2112 – Short Duration Fires
    - Intensity Matters – Heat Flux vs. Duration
  - NFPA 70e – Arc Flash
    - Are All Your Employees at Risk?

- Proper worker PPE must match recognized hazards within the individual organization and equipment utilized
- Necessity for self-analysis of risk assessment
- Consider the tradeoffs of protection not needed.
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Summation - Takeaways

Is Your Current PPE Program Optimized For All Important Characteristics?

- Hazard Risk
  - NFPA 2112 – Short Duration Fires
  - NFPA 70E – Arc Flash

- Wearer Comfort

- Durability
  - Flame Resistant Properties
  - Wear Properties and Wear Life

- Cost Considerations
  - Initial Cost vs. Total Life Cycle Cost

- Ease of Care and Long Term Appearance
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Thank You
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Questions