Standards - Compliance vs Certification

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Webinar Overview

Introduction

OSHA General Duty Clause – Compliance Supporting Standards

OSHA PPE Requirements – Compliance Supporting Standards

OSHA Hazard Assessments – Compliance Supporting Standards
  - Scope
  - Specific Hazard (Fire and Arc) Standards – PPE Focus

Compliance - Impact on Worker Protection

Summary
Introduction
Compliance: 

the act of obeying an order, rule, or request: 2

Certification: 

Proof... of qualification for a particular job, or that something is of good quality: 2

The law requires employers to provide their employees with working conditions that are free of known dangers.

May recognize key consensus standards as useful or acceptable for compliance with OSHA regulations

Consensus Standards

committees composed of volunteer industry representatives; suppliers, manufacturers, industry experts, end users

1. U.S. Department of Labor, Occupational Safety and Health Administration, OSHA 3021-11R 2016
Standards – Compliance vs Certification

Compliance vs Certification and Impact on Protection

Compliance:
the act of obeying an order, rule, or request: 2

Certification:
Proof... of qualification for a particular job, or that something is of good quality: 2

OSHA®
www.osha.gov

ASTM INTERNATIONAL

ANSI
American National Standards Institute

NFPA®

NESC

ISO

Does compliance with required standards, using certified PPE solutions, assure adequate worker protection?


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Standards – Compliance

OSHA General Duty Clause
OSHA Regulatory Standards – Law with Prosecutorial Consequences

MEMORANDUM OF UNDERSTANDING BETWEEN
THE U.S. DEPARTMENTS OF LABOR AND JUSTICE
ON CRIMINAL PROSECUTIONS OF
WORKER SAFETY LAWS

12/17/15

https://www.justice.gov/enrd/file/800526/download

In a memorandum sent to all 93 U.S. attorneys, prosecutors were encouraged to work with their local ECS coordinator to increase the frequency and effectiveness of criminal prosecutions for worker safety violations. Specifically, prosecutors were asked to consider charging individuals under Title 18 and environmental offenses as a means to enhance penalties for worker safety crimes.

http://www.safetyandhealthmagazine.com/articles/13907-facing-time

Atlantic States Cast Iron Pipe Company:

Former managers convicted and sentenced stemming from a number of safety and environmental incidents, and subsequent efforts of cover-up, at Atlantic’s Phillipsburg, NJ plant.

Company placed on four years’ probation and required to pay an $8 million fine. In addition, 4 company managers were sentenced as follows:

- 70 months in prison for the former plant manager;
- 41 months in prison for the former human resources manager in charge of safety;
- 30 months in prison for the former maintenance supervisor; and
- 6 months in prison for a former supervisor.


Ignorance of The Regulations Does Not Absolve Responsibility

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U.S. Code, Title 29 Chapter 15 § 654 (General Duty)

General Duty Clause, Section 5(a)(1) of the Occupational Safety and Health Act (OSHA) of 1970, employers are required to provide their employees with a place of employment that "is free from recognizable hazards that are causing or likely to cause death or serious harm to employees."

Key U.S. Government Regulations (OSHA)
- U.S. Code, Title 29 Chapter 15 § 654 (General Duty)
- 29 CFR 1910.132 (PPE General Requirements)
- 29 CFR 1910.335 (Electrical Safety — Protection)
- 29 CFR 1910.269 (Electrical T and D Operation)
- 29 CFR 1926.951 (Electrical T and D Construction)
- 29 CFR 1910.252 (Welding, Cutting, Brazing)

With respect to the General Duty Clause, industry consensus standards may be evidence that a hazard is "recognized" and that there is a feasible means of correcting such a hazard.

Standards – Compliance vs Certification

**U.S. Government (OSHA)**
- U.S. Code, Title 29 Chapter 15 § 654 (General Duty)
- 29 CFR 1910.132 (PPE General Requirements)
- 29 CFR 1910.335 (Electrical Safety — Protection)
- 29 CFR 1910.269 (Electrical T and D Operation)
- 29 CFR 1926.951 (Electrical T and D Construction)
- 29 CFR 1910.252 (Welding, Cutting, Brazing)

**Industrial Consensus Specification Standards**
- NFPA 2112 (Flame Resistant Garments – Fire)
- NFPA 2113 (Flame and Thermal for Industrial)
- NFPA 70E (Protection from Electric Arc, Industrial)
- NESC / ANSI C2 (Electrical T and D)
- ANSI 107 (High-Visibility Safety Apparel)
- ASTM F-1506 – FR and Arc Rated Textiles
- NFPA 652 & 654 – Combustible Dust

**Test Methods**
- ASTM F-1959 – Arc Flash Test Method
- ASTM F-1930 – Thermal Manikin Test
- ASTM D6413 – Vertical Flame

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**Key Thermal Protection Regulations – North America**

**Compliance**
- Regulatory

**Aid For Compliance**
- Product Certification
- Voluntary

**Supportive**
- OSHA Regulations
- Consensus Standards
- Test Methods

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Standards – Compliance

OSHA PPE Requirements
This guide will help both employers and employees do the following:

➢ Understand the types of PPE.
➢ Know the basics of conducting a “hazard assessment” of the workplace.
➢ Select appropriate PPE for a variety of circumstances.
➢ Understand what kind of training is needed in the proper use and care of PPE.

OSHA Publication 3151-12R 2003

https://www.osha.gov/Publications/osha3151.pdf

1910.132(d)(1)
Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;

➢ Communicate selection decisions to affected employees
➢ Select PPE that properly fits each affected employee...

1910.132(f)(1)
The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:

➢ When PPE is necessary;
➢ What PPE is necessary;
➢ How to properly don, doff, adjust, and wear PPE;
➢ The limitations of the PPE; and,
➢ The proper care, maintenance, useful life and disposal of the PPE
➢ Employee shall demonstrate understanding of training
➢ Employee Retraining
   ▪ Workplace or PPE changes
   ▪ Insufficient employee knowledge
Employers Must Pay for Workers PPE

OHSA 29 CFR 1910.132

1910.132(h)
Payment for protective equipment.

1910.132(h)(1)
Except as provided by paragraphs (h)(2) through (h)(6) of this section, the protective equipment, including personal protective equipment (PPE), used to comply with this part, shall be provided by the employer at no cost to employees.

1910.132(h)(5)
The employer must pay for replacement PPE, except when the employee has lost or intentionally damaged the PPE.

1910.132(h)(7)
This paragraph (h) shall become effective on February 13, 2008. Employers must implement the PPE payment requirements no later than May 15, 2008.

**OHSA 29 CFR 1910.132**

1910.132(f)(1)(v): The proper care, maintenance, useful life and disposal of the PPE.

### OSHA Issued Letter of Interpretation

**Question:**

Under OSHA regulations 29 CFR 1926.95(a) who is responsible for the laundering of fire retarding clothing that is provided to employees?

**Answer:**

Criteria for Personal Protective Equipment - Title 29 CFR 1926.95(a) section states:

(a) Application. Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition ...

29 CFR 1926.95(a), standard does not prohibit home laundering of FR and arc-rated clothing if the employer permits it. However, to comply with 1910.132 or 1926.95, The Employer:

- Cannot simply instruct employees to follow manufacturers' instructions
- Must ensure that protective clothing such as FR garments are adequately maintained
- Must ensure the FR garment is laundered so contaminants (e.g. dirt, oils, etc.) will not affect the performance of the garment
- Must inspect the clothing on a regular basis to ensure that it is not in need of repair or replacement
- If employers rely on home laundering, they must train their employees in proper laundering procedures and techniques
- If employer cannot meet these conditions, then the employer is responsible for laundering the FR and arc-rated clothing.

**FR Performance Assurance**

**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
Proper FR PPE Garment Care – Home Laundering

ASTM F-2757 Standard Guide for Home Laundering Care and Maintenance of Flame, Thermal and Arc Resistant Clothing

This guide is intended for use by employees of the end user, such as safety personnel or program administrators, who have chosen to implement a home laundered flame, thermal or arc resistant clothing program.

- Describes the key components involved in the home care and maintenance of flame, thermal, and arc resistant clothing.
- Provides the end user assistance to develop laundering methods that will clean the garment and maintain the flame, thermal, and arc resistant characteristics of the clothing during its useful service life.
- Provides suggestions for increasing the wear life, appearance and function of the clothing; and suggestions as to when flame, thermal, and arc resistant garments should be removed from service.

NOTE - The National Institute for Occupational Safety and Health (NIOSH) recommends leaving clothing soiled with hazardous chemicals at work to be laundered by the employer.
ASTM F-1449 Standard Guide for *Industrial Laundering* of Flame, Thermal, and Arc Resistant Clothing

This guide provides guidelines for use by suppliers of the flame, thermal, and arc resistant clothing (including the fabric and fibers used in its construction), processors, and end users to effectively care for and maintain flame, thermal, and arc resistant clothing.

- Identifies the responsibilities of the fiber, fabric, and clothing manufacturers, as well as the processor, the processor’s chemical supplier and the end user.
- Describes the key components involved in a program for the care and maintenance of flame, thermal, and arc resistant clothing.
- Provides a processor assistance to develop a processing system that maintains the flame, thermal, and arc resistant characteristics of the clothing during its useful service life.
- Provides suggestions as to when flame, thermal, and arc resistant garments should be removed from service.
Standards – Compliance vs Certification

OSHA Required Hazard Assessments
OHSA 29 CFR 1910.132

1910.132(d)(1)
The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE).

1910.132(d)(2)
The employer shall verify that the required workplace hazard assessment has been performed through a written certification that identifies the workplace evaluated; the person certifying that the evaluation has been performed; the date(s) of the hazard assessment; and, which identifies the document as a certification of hazard assessment.

The Occupational Safety and Health Review Commission (OSHRC) ruled that hazard assessments undertaken... must accurately reflect the hazards encountered by employees at each specific facility, regardless of any operational or design similarities across multiple worksites.

Federal appeals court upheld the U.S. Department of Labor's rule interpretation requiring employers to conduct hazard assessments in the workplace...

http://www.ca5.uscourts.gov/opinions/pub/15/15-60462-CV0.pdf
Hazard Risk Assessment
comprehensive and all encompassing process of identifying and assessing hazards, estimating the potential severity of worker injuries, assessing the likelihood of occurrence of injury and determining protective measures to lower the risk to acceptable levels.

Hazard Analysis
A hazard analysis is a primary step in a hazard risk assessment. The result of a hazard analysis is the identification of different type of hazards.

Understand Risk and Probability of Injury, Loss or Consequences

Acceptable or Tolerable level of risk

Tolerable Risk

Risk is a function of two variables:
Probability and Severity

ISSUE
Perceived Risk ≠ Actual Risk

Comprehensive Hazard Assessment Will Ensure Actual Hazard Risks Are Known

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Considerations When Selecting a Particular Process or Method of Hazard Risk Assessment

- Stakeholders’/Workers’ Needs
- Acceptance Criteria – Stakeholders and Decision Makers
- Regulatory Requirements and Industry Precedents
- Legal Responsibilities and Issues
- Available Resources – Personnel Expertise, Time, Costs

Hazard Assessment Resources and Tools

- OHSA 29 CFR 1910.269 – Appendix E
- IEEE Std. 1584 - Guide for Arc Flash Hazard Calculations
- NFPA 70E
- NESC – National Electrical Safety Code
- Center for Chemical Process Safety
- NFPA 551
- NFPA 2113
- ANSI Z690.3-2011 Risk Management – Principles and Guidelines
- OECD Manual for the Assessment of Chemicals
- American Chemistry Council – Principles for Hazard and Risk Assessments
- Sandia National Laboratories – Biosafety Risk Assessment Methodology
- NFPA 652
- Consultants and Industry Experts
Arc Flash Risk Assessment
NFPA 70E - Annex F
Risk Assessment Procedure

Risk Assessment (General)
- Goal - Determine measures necessary to reduce likelihood of injury
- Hazard Identification and Analysis
- Responsibility

Risk Assessment
- Risk Estimation
- Possibility /Severity of Injuries
- Likelihood of avoiding hazardous event and injuries

Risk Reduction
- Protective Measures
- Controls, Awareness Devices, Procedures, Training
- PPE

Risk Evaluation
- Risk Reduction measures’ effect on risk

Risk Reduction Verification

Figure E.1(a) Risk Assessment Process.
Hazard Assessment – Combustible Dust

**Combustible Dust:**

solid material composed of distinct particles or pieces, regardless of size, shape, or chemical composition, which presents a fire or deflagration hazard when suspended in air or some other oxidizing medium over a range of concentrations

NFPA 652

Chapter 4 - General Requirements

4.1* General The owner/operator of a facility with potentially combustible dust shall be responsible for the following activities:

1. Determining the combustibility and explosibility hazards of materials in accordance with Chapter 5
2. Identifying and assessing any fire, flash fire, and explosion hazards in accordance with Chapter 7
3. Managing the identified fire, flash fire, and explosion hazards in accordance with 4.2.4
4. Communicating the hazards to affected personnel in accordance with Section 9.5

The CSB reviewed Material Safety Data Sheets (MSDS) of 140 known substances that produce combustible dusts

- 41% of the MSDSs reviewed did not warn users about potential explosion hazards.
- remaining 59% of MSDSs information not stated in a place or manner clearly recognized by workers, or was not specific to hazards related to combustible dusts


“Hazard Communication Guidance for Combustible Dusts” U.S. Department of Labor Occupational Safety and Health Administration, OSHA 3371-08, 2009

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Hazard Assessment – Combustible Dust

General Industry (29 CFR 1910)

- General Duty Clause
- 1910 Subpart D, Walking-working surfaces [related topic page]
  - 1910.22, Housekeeping
- 1910 Subpart E, Exit routes, emergency action plans, and fire prevention plans
  - 1910.38, Emergency action plans [related topic page]
- 1910 Subpart G, Occupational health and environmental control
  - 1910.94, Ventilation [related topic page]
- 1910 Subpart J, General environmental controls
  - 1910.146, Permit-required confined spaces [related topic page]
- 1910 Subpart L, Fire protection [related topic page]
  - 1910.157, Portable fire extinguishers
  - 1910.165, Employee alarm systems

1910 Subpart N, Materials handling and storage
- 1910.176, Handling materials - general
- 1910.178, Powered industrial trucks [related topic page]

1910 Subpart R, Special industries
- 1910.261, Pulp, paper, and paperboard mills [related topic page]
- 1910.263, Bakery equipment
- 1910.265, Sawmills [related topic page]
- 1910.269, Electric power generation, transmission, and distribution [related topic page]
- 1910.272, Grain handling facilities [related topic page]

1910 Subpart S, Electrical [related topic page]
- 1910.307, Hazardous (classified) locations

1910 Subpart Z, Toxic and hazardous substances [related topic page]
- 1910.1200, Hazard communication [related topic page]

https://www.osha.gov/dsg/combustibledust/standards.html
Some risk from all – Mitigate the greatest risk first
- Ensure efforts to mitigate secondary risks do not compromise protection from the primary risk – (i.e. wearing non-FR outer layers in a fire risk environment)
- Ensure protection from a hazard does not create its own hazard - (i.e. heat stress)
- May need to re-evaluate risk solutions (engineering controls, work procedures etc.) to safely incorporate all concerns simultaneously
Standards – Compliance

**OSHA Required Hazard Assessments**

*Short Duration Fire – Arc Flash PPE*
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

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

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  - 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

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**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

**NESC: National Electrical Safety Code®**

- Code covers basic provisions for safeguarding workers engaged in the installation, operation, and maintenance of electric supply and communication facilities
- Standard of safe practices for adoption by public/private utilities and commissions
- NESC is a voluntary standard – State by State adoption decisions (part or full)
- Assists in complying with OSHA 29 CFR 1910.269
- Establishes work and safety rules for installation, operation, and maintenance
- Establishes guard zones and clearance distances
- Incident energy analysis tools
- Appropriate PPE selection – Clothing and Equipment
ASTM F1506

Standard Performance Specification for Flame Resistant Textile Materials for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards

➢ Provides Min Requirements for FR Arc Materials
  o Sewing Thread, Findings, Closures
  o Physical Characteristics (e.g., Fabric Strength)
  o Laundering Colorfastness & Shrinkage
  o Vertical Flammability (New and 25x Cleaning Cycles)
  o Labeling Specifics (Arc Rating, Fiber Content, etc.)

➢ Primarily for Manufacturers
  o Testing Reports Available to Garment Purchasers

➢ Manufacturer Self-Certification

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**ASTM F-1930**

**Thermal Manikin – Short Duration Fire**

- **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
  - Predicted Burn Injury & Probability of Survival
- **Jet Fire Exposure**
  - 2 cal/cm² s Heat Flux & Variable Duration

**ASTM F-1959**

**Electric Arc Flash**

- **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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**ASTM F-1930 and F-1959 Are Not Compliance or Certification Standards**
<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>TPBI – Total Predicted Burn Injury Minimum Performance Standard Pass/Fail</td>
<td>ATPV – Arc Thermal Performance Value EBT – Energy Break Open Threshold</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>

**Same Incident Energy Levels Present Different Hazards for Fire and Arc Flash**
Impact on Protection
Standards – Compliance vs Certification

Hazard Assessment Criticality

Before Electric Arc Flash

During Electric Arc Flash

Arc Rated PPE

After Electric Arc Flash

Typical Work Clothes

Non-Arc Rated PPE can Ignite and Continue to Burn
Nomex® IIIA Coverall vs. Typical Non-FR Cotton Work Wear

Thermal Manikin before and during an ASTM F1930 exposure

Total 6 cal/cm² - 2 cal/cm²'s heat flux @ 3 seconds

NFPA 2112 minimum requirement
Standards – Compliance vs Certification

Hazard Assessment Criticality

**Predicted Burn Injury**

NOMEX® IIIA, 6 oz/yd²

- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- **Predicted Burn Injury: 10.7%**

100% Non-FR Cotton Shirt and NON-FR Cotton Jeans

- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- **Predicted Burn Injury: 86.9%**
Predicted Burn Injury Survivability Test Data

**NOMEX® IIIA, 6 oz/yd²**

- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- **Predicted Burn Injury: 10.7%**

**100% Non-FR Cotton Shirt and NON-FR Cotton Jeans**

- 3 seconds @ 2.0 cal/cm²s
- Total Exposure: 6.0 cal/cm²
- **Predicted Burn Injury: 86.9%**

Standards – Compliance vs Certification

Hazard Assessment Criticality
Aren’t all “Flash” fires 3 second duration and 2 cal/cm²s or less?

➢ Identified in NFPA 2112 for Thermal Manikin Testing

DOE China Lake Experiments with LNG Vapor Cloud Fires

➢ 28 m³ spills occurring in ~1.6 min
➢ Measured peak heat flux values of over 7.2 cal/cm²s
➢ Duration (~< 5 sec).

DOE China Lake Experiments with LPG Vapor Cloud Fires

➢ 5.8 m³ (1,530 gal) release.
➢ Measured an average heat flux value of 3.3 cal/cm²s
➢ Duration (~ 16 sec)


➢ 25 gallons JP-4 fuel spread over a 30 ft. x 20 ft. pit then ignited
➢ Average fuel burn time ~ 30 seconds
➢ Measured peak heat flux values of over 6.5 cal/cm²s
➢ Average measured heat flux on instrumented manikin ~ 2.9 cal/cm²s

Duration X Heat Flux = Total Energy

Garment Certification Alone Does Not Ensure Optimal Worker Safety

Consider potential exposure slightly above NFPA 2112 certification minimum

\[
\text{Total } 2.0 \text{ cal/cm}^2 \text{s heat flux @ 3 seconds} = \text{Total 6 cal/cm}^2
\]

- 2.0 cal/cm\(^2\) s heat flux @ 4 seconds
- 2.66 cal/cm\(^2\) s heat flux @ 3 seconds
- 4.0 cal/cm\(^2\) s heat flux @ 2 seconds

Total 8 cal/cm\(^2\)
Standards – Compliance vs Certification

**Predicted Burn Injury**

**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%
Predicted Burn Injury Survivability

NOMEX® IIIA, 6 oz/yd²

- 4 seconds @ 2.0 cal/cm²-s
- 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/cm²-s
- Total Exposure: 8.0 cal/cm²
- Predicted Burn Injury: 69.7%
Standards – Compliance vs Certification

**Match Applicable Standards for the Hazard**

**Thermo-Man® ASTM F-1930 Comparison**

- **Nomex® IIIA 6 oz**: 34.40%
- **88/12 FRT Cotton Nylon 7 oz**: 69.70%

**Arc Flash Protection**

- **PPE Category 1**: ASTM F-1930 2.0 Cal/cm2 - 3s
- **PPE Category 2**: ASTM F-1930 2.0 Cal/cm2 - 4s

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Contaminates on the garment burned for another 8 seconds after the burner flames were extinguished.

How Clean are Your Garments?
Soil Release Properties

Decontamination Efficiency (%)\(^2\)
Note: Higher the Efficiency, the Better the Removal of Contaminant

<table>
<thead>
<tr>
<th></th>
<th>Nomex® IIIA</th>
<th>FR Cotton/Nylon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Only</td>
<td>0%</td>
<td></td>
</tr>
<tr>
<td>Pre-Wash Only</td>
<td>84%</td>
<td></td>
</tr>
<tr>
<td>Detergent Only</td>
<td>95%</td>
<td></td>
</tr>
<tr>
<td>Detergent and Pre-wash</td>
<td>98%</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Amount of residual oil and decontamination efficiency (%)\(^2\)

<table>
<thead>
<tr>
<th></th>
<th>Fabric (Nomex® IIIA)</th>
<th>FR Cotton/Nylon (88/12 Blend)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Only (No Detergent/No Pre-wash)</td>
<td>63.2g (42.8%)</td>
<td>103.0g (4.3%)</td>
</tr>
<tr>
<td>Pre-wash Only (No Detergent)</td>
<td>13.8g (87.5%)</td>
<td>46.8g (56.4%)</td>
</tr>
<tr>
<td>Detergent Only (No Pre-wash)</td>
<td>14.5g (86.8%)</td>
<td>76.7g (28.7%)</td>
</tr>
<tr>
<td>Detergent and Pre-wash</td>
<td>14.0g (87.3%)</td>
<td>46.3g (57.0%)</td>
</tr>
</tbody>
</table>

The contaminant in the study is new motor oil with tritiated-triolein as a tracer. Residual oil amount and decontamination efficiency is the percent of contaminant removed by each method measured by radiotracer analysis and scanning electron microscopy. Decontamination was performed in a 10-minute small load heavy duty wash cycle at 60°C in 400ml of water and 4g of detergent, followed by 2 rinse cycles at 30°C at 5 minutes and 3 minutes.

1) The independent study was conducted by the Department of Human Ecology, University of Alberta.

CAUTION: This particular contaminant may not mimic soils in every situation. Flame-resistant protective garments need to be free from any flammable contaminant.
Summary
Conclusions and Summary

- OSHA Standards are Regulatory - Federal Law
- Consensus Standards Can Be Invaluable for OSHA Compliance
- Employers Have Many PPE Responsibilities
- OSHA Required Hazard Assessments Are the Basis for Ensuring Worker Safety
- Use of Certified PPE Does Not Guarantee Compliance or Adequate Worker Protection
- Match Applicable Standards to Your Specific Assessed Hazard

Is Compliance Enough to Fully Protect Your Workers?
Thank You
Disclaimer

- “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. DuPont Thermo-Man® thermal protection system is based on ASTM Standard F 1930 (2008) which applies to flame resistant clothing. These conditions may not by typical of the conditions encountered in actual situations. The results of these tests are only predictions of body burn injury under these specific laboratory conditions. These results do not duplicate or represent garment or fabric performance under actual flash fire conditions. The user is solely responsible for any interpretations of the test data provided by DuPont, and included in this material, and for all conclusions and implications made concerning the relationship between mannequin test data and real life burn injury protection. SINCE CONDITIONS OF USE ARE OUTSIDE OUR CONTROL, DUPONT MAKES NO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE AND ASSUME NO LIABILITY IN CONNECTION WITH ANY USE OF THIS INFORMATION. This data is not intended for use the user or others in advertising, promotion, publication or any other commercial use and is not a license to operate under, or intended to suggest infringement of, any existing trademarks or patents.”

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