68TH AMEU CONVENTION 2022

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A JUST ENERGY TRANSITION ("JET") FOR SOUTH AFRICA

The Evolution of SANS 724 performance standards. Protecting workers against the effects of an electric arc

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Thermal Industrial Sales Manager

DuPont™

Hosted by

ETHEKWINI MUNICIPALITY

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2. Causes of an electric arc
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DuPont Aims to Help Safety Managers with the Challenges Faced by Electric Arc

Ralph H. Lee

Ralph Lee – A Pioneer for Electric Arc Hazards

- 1934 Degree from the University of Alberta
- DuPont Career 1942-1976
- Industry-recognized expert on Electrical Safety
- **„The Other Electrical Hazard – Electric Arc Blast Burns " published in 1981**

INDUSTRY CHALLENGES...

- **Assess Electrical Arc Hazard severity**
- **Comply with EU Directives**
- **Implementation of risk reduction & protection measures**
- **Selection of Appropriate PPE for residual risks**

DuPont Engineering Research & Technology

DuPont Protection Technologies- Makers of Nomex®

Expert External Consultants

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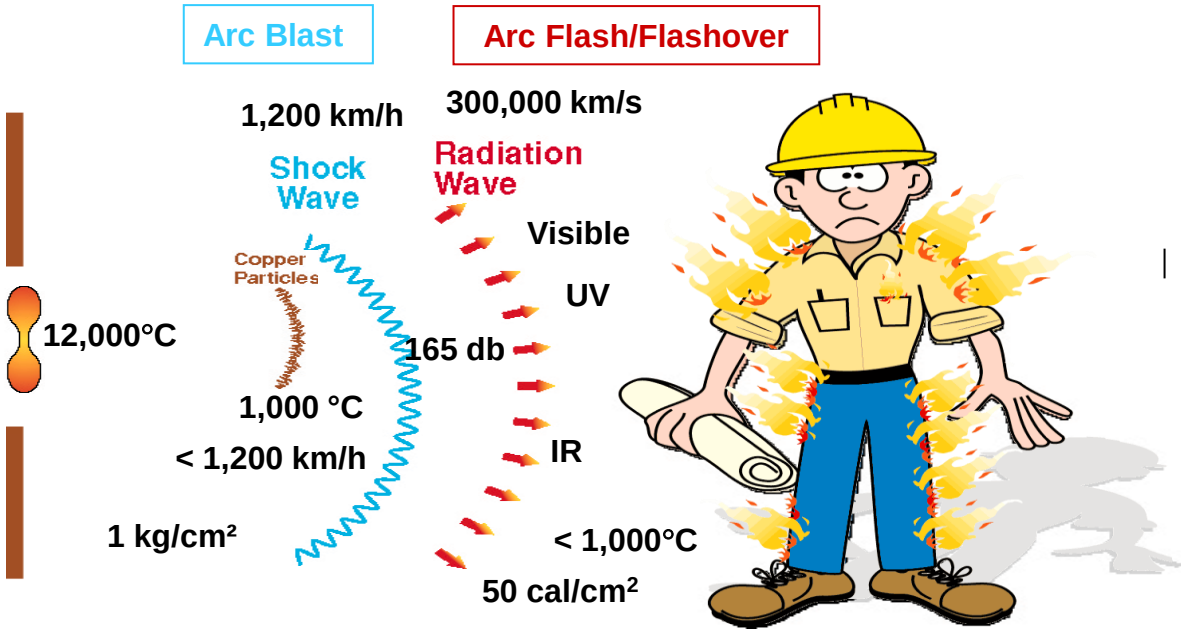
What Happens During An Electrical Arc ?



Associated risks:

- Burn injury through arc radiation energy or molten metal splashes
- Noise & pressure injury through shock wave
- Inhalation injury

Electrical Arc Hazard

- **A continuous electric discharge of high current between two electrodes, generating very bright light and intensive heat.**

- ***5-10 electrical arc accidents occur per day in the USA.***
  (Source: www.arcadvisor.com)

- **Possible causes of electrical arcs:**
  - accidental contact with energized parts eg. during switching operations
  - contamination such as dust on insulating surfaces
  - wiring errors
  - corrosion of equipment parts and contacts
  - improper work procedures

- **Factors determining the heat energy of an electrical arc**
  - Amount of current discharged
  - The duration of the arc is determined by the speed of the over-current protective devices, e.g. < 1 s for typical fuses.
  - The distance between the worker and the arc
  - The confinement of the arc

Protection against thermal effects of an electric arc:

- *IEC 61482-2 "Protective clothing against the thermal hazards of an electric arc – Part 2: Requirements"-SANS 724*

  - ✓ <u>Material arc testing:</u>
    - ✓ Open arc test (IEC 61482-1-1/Method A): Arc Thermal Performance Value (ATPV) and/or Break-open Threshold Energy (EBT)
  - ✓ <u>Garment arc testing</u>
    - ✓ Open arc test (IEC 61482-1-1/Method B): pass visual evaluation when tested at arc rating incident energy
      and/or

SANS 724

IEC 61482-1-1 (Open Electric Arc Safety Concept)

Workers are assumed safe if the following condition is fulfilled:

Arc rating of protective clothing	>	Calculated arc incident energy

Arc Thermal Performance Value (ATPV)

- Maximum incident thermal energy (cal/cm^2) that the fabric can support before wearer will suffer onset of second degree burns. (Mini. 20 test results)

Breakopen threshold energy (E_{BT})

- Highest incident energy exposure value on a fabric below the Stoll curve where the specimens do not exhibit break open. (Mini. 5 test results - recommend 10)

Minimum Single layer
ATPV = 167,5 kJ/m²
(4 cal/cm²).

Predict : Arc Flash Hazard Assessment

How to assess the severity of the hazard?

- 1.2 cal/cm^2 applied to skin for 1 second: the threshold for the onset of second degree burns
- Calculate the „Incident Energy“, which defines the severity of the arc flash at workers' distance
  - Expressed in kJ/m^2, J/cm^2, or cal/cm^2
- Calculate Arc flash boundary
  - Expressed in m, cm
- Recognized methods for Incident Energy Calculation are given in :

IEEE 1584-2002: Guide for Performing Arc Flash Hazard Calculations

How to review different fabric solutions

DUPONT
Kevlar | Nomex | Tychem | Tyvek

Protection

WHY NOT EVERYDAY CLOTHING ?

- Everyday conventional fabrics can ignite and continue to burn on the body, increasing the extent of a worker's burn injury
- Fabrics which IGNITE include:
  - **Cotton, viscose, wool**
- Fabrics which IGNITE and MELT include:
  - **Polyester, Nylon, acetate, rayon**

PURPOSE OF FLAME RESISTANT (FR) FABRICS

Reduce Burn Injury and Increase Chance of Survival

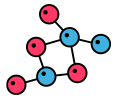
- Does Not Ignite and Continue to Burn
- Does Not Melt and Drip
- Maintains a Barrier
- Insulates the Wearer from Heat
- Resists Breaking Open
- Provides Valuable Escape Time

However, Burn Injuries Can Occur In Spite Of The Use of FR Clothing

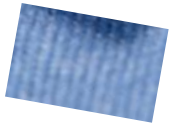
TYPES OF FLAME RESISTANT / RETARDANT (FR) FABRICS

Not All FR Is Made The Same

- **Inherent**
  - FR performance is present in the DNA / chemistry of the fiber at the time of production
  - Fiber molecular structure does not support combustion



- **Chemically Treated**
  - After fabric is manufactured, it is treated with flame retardant chemicals to make it flame resistant (FR)
  - Produces char/gases to inhibit combustion



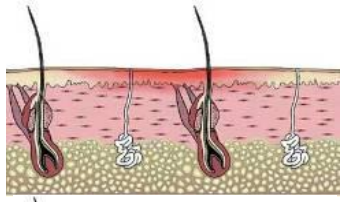
Burn Injury Fundamentals

- Normal skin temperature @ 32.5 ° C
- Skin burn onset @ > 44 ° C
- Instantaneous @ 72 ° C

- Burn depth is a measure of severity

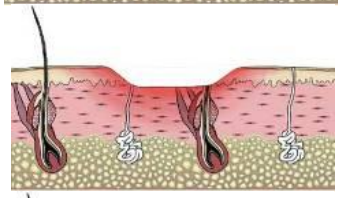
First degree burn – outer skin layer

(sunburn, no blister)



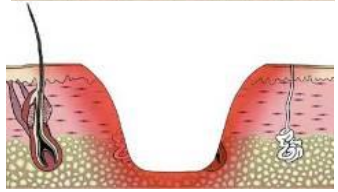
Second degree burn- middle skin layer

(blisters, skin can regenerate)



Third degree burns- deep skin layer

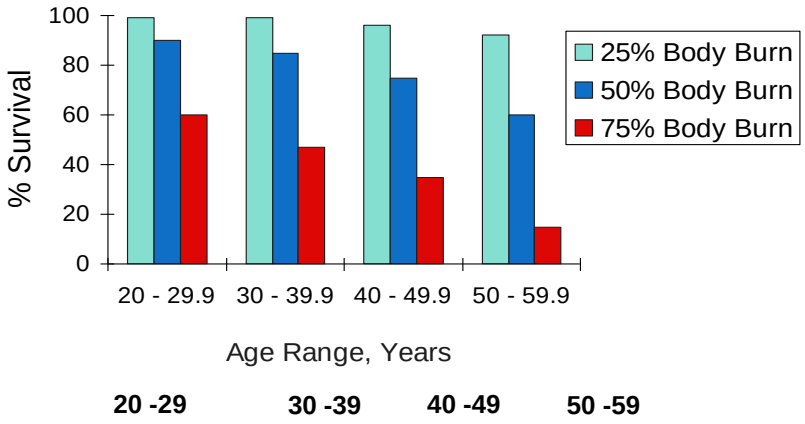
(grey skin, charred, no skin regeneration possible)



Onset of 2 deg burn @ 1.2 Cal/cm2

Predicted Survival Rates

- Body Burns are predictor of expected survival rates.



Source: American Burn Association (1991-1993 Study)

Survival from burn injury depends on 2 factors:

- ⇨ **% Body burn**
- ⇨ **Age of the injured person**

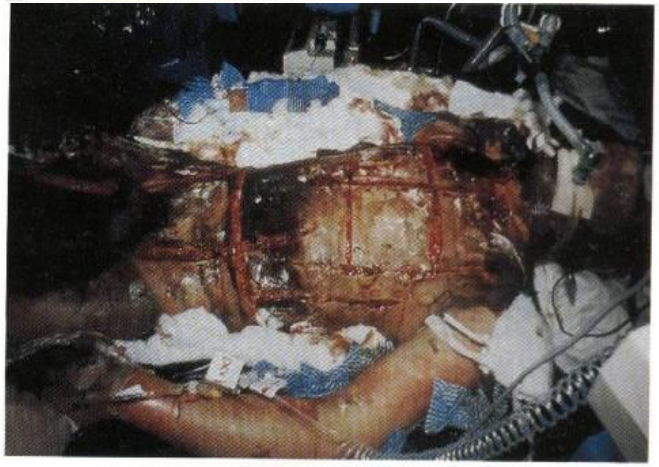
Skin Burn Evaluation

Second degree burns

(blisters, skin can regenerate)

Third degree burns

(grey skin, charred, no skin regeneration possible)



Photos courtesy DuPont

Simulated Electric Arc Flash: Inherent fabric during an arc

Before Electric Arc Flash

During Electric Arc Flash

After Electric Arc Flash

The garment made of Nomex® Essential Arc did not ignite nor break-open !

Arc test report

Report # K-418406-1208P16

Samples Received: AUG 1, 2012

Samples Tested: AUG 16, 2012

Test Report

Kinectrics Inc., 800 Kipling Avenue, Unit 2
Toronto, Ontario, Canada
Tel: 416-207-6000, www.kinectrics.com

KINECTRICS
ISO 9001-2008

Tested for

Hugh Hoagland
ArcWear.com
502-333-0510
arctesting@arcwear.com

Contact information for item tested:

Reiyao Zhu/Dave Klinger
DuPont
804-383-3977
reiyao.zhu@usa.dupont.com

Test item description

DuPont, Springfield, Style Protera®, 8.0 oz/yd² 271 g/m² Twill, Aramid Modacrylic, Navy Blue, AAD 8.4 oz/yd² 285 g/m², ArcWear# 1208P16

Reference Standard

ASTM F1959/F1959M-06ae1
Standard Test Method for Determining Arc Thermal Performance of Textile Materials for Clothing by Electric Arc Exposure Method

Test Parameters:

Test current: 8 kA
Distance to Fabric: 30 cm
Arc Gap: 30 cm

Number of samples analysed: 27

Incident Energy Range: 8 to 26 cal/cm²

Arc Rating, ATPV = 12 Cal/cm²
Material Break-Open, Ebt = 19 Cal/cm²
Heat Attenuation Factor, HAF = 82%

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Thank you

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