

Arc Flash

Extreme Danger

BCMSA Presentation

Presented by:

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Unlimited PPE Inc.

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Presentation Agenda

- ☐ Introduction
- ☐ Basics
- ☐ CSA Z462-2015 Changes
- ☐ Employer Impacts
- ☐ Updates on 2015 Training
- ☐ Arc-rated PPE
- ☐ Questions & Answers



Introduction

WHY

I believe every electrical fatality was preventable.

HOW

Connecting Clients with the best available products and services so workers are safe and compliant.

WHAT

Arc Flash & Shock PPE, Arc Flash Training, eLearning Courseware, Electrical Safety Programs, Consulting and Audits

Disclaimer

- Not all potential changes to CSA Z462, 3rd Edition are presented here.
- You are cautioned to consult CSA Z462-2015 prior to making any changes in any safe work practices that are established.
- Opinions expressed by the presenter is a personal technical opinion. You are advised to consult the Canadian Standards Association for specific formal interpretation.
- Forms, Flowcharts and Graphics are provided by ESPS Electrical Safety Program Solutions Inc.

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- ☒ **Cover the Basics**
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Easy Guide –What is an Arc Flash?

1. Electric Arc is the Passage of Substantial Electric Current Through Ionized Gases.
2. Arc Flash Hazard is a Dangerous Condition associated with the possible release of energy caused by an Electric Arc.
3. Typically lasts less than 1 Second.
4. Extremely High Thermal Energy.
5. Explosive in Nature.

Easy Guide –When can it happen?

Workers perform tasks that put them at Risk including;

1. Voltage Testing.
2. Removing Bolted-on Panel Covers.
3. Inserting or Removing Circuit Breakers.



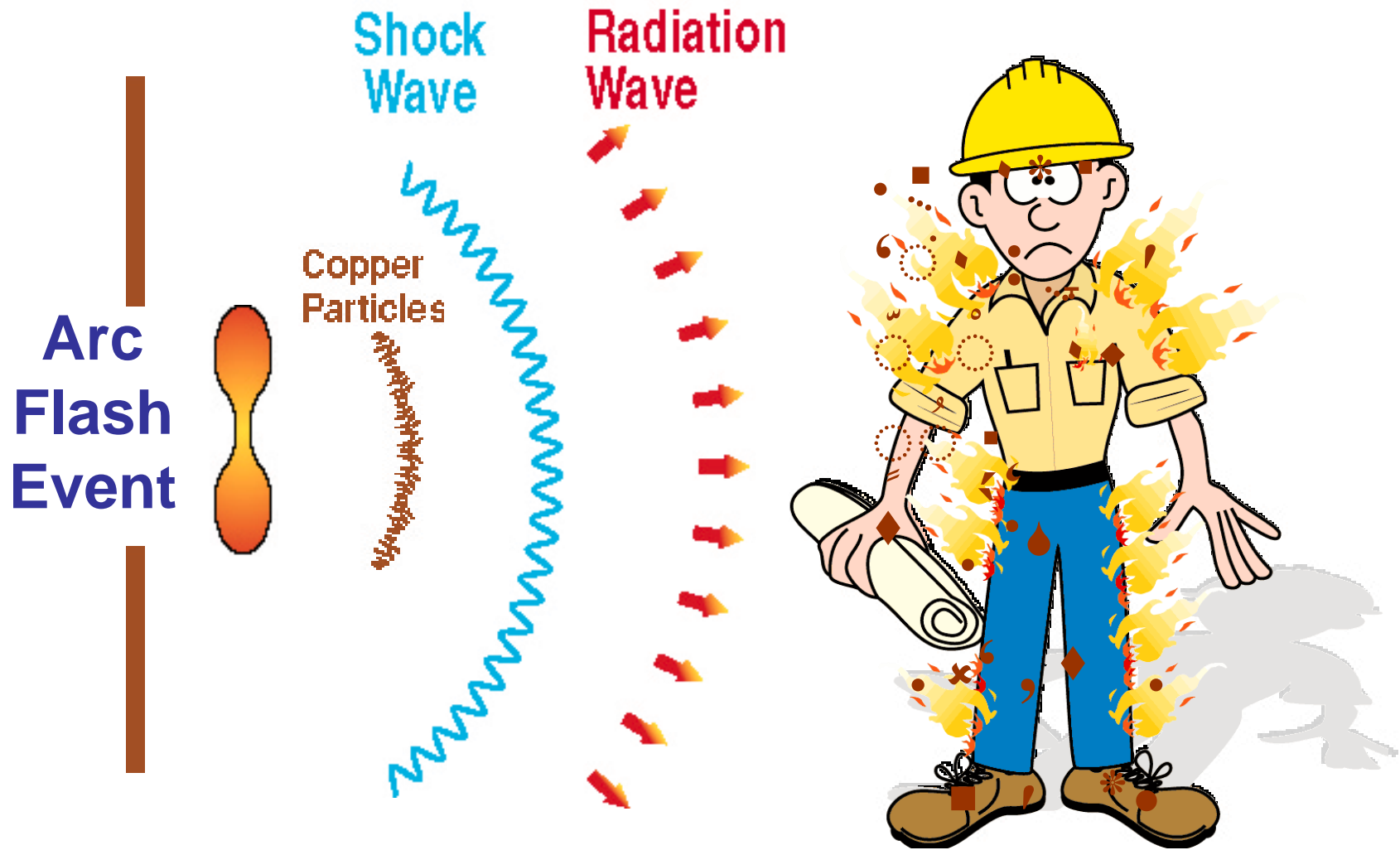
Easy Guide –How can it happen?

1. Conductive Object gets too close to an energized conductor or circuit part and ground.
2. Electric Arc super heats and ionizes the air, allowing for a path for electrical current to flow.
3. With sufficient voltage (>208 V) the Electric Arc can sustain itself and transform into an Arc Flash.

What is the Cause?

Equipment Failure and Human Interaction

Arc Flash Hazard



Easy Guide –Alphabet Soup



Digital Copy on www.unlimitedppe.com

Industry Score Card

- Industry realizing that we've over risked Arc Flash hazards resulting in new CSA Z462 clarity.
- Arc Flash economy still going strong. Mostly due to Equipment Manufacturers and Engineering Companies.
- Lack of Competency Validation, **poor training**.
- Absence of effective documentation for Electrical Hazard management, i.e. Workflow process, Electrical Safety Program, Risk Assessments.





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Differences Document

	Document: ELECTRICAL SAFETY PROGRAM		Subject: Differences CSA Z462, 2 nd Edition to CSA Z462, 3 rd Edition		
	Issued by: TWB/JDP	Approved by: TWB	Rev # 1.0	Rev Date: Oct 5, 2014	

DIFFERENCES CSA Z462, 2nd EDITION TO CSA Z462, 3rd EDITION

Provided to you by:



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CSA Z462 First Past Vice-Chair, Voting Member, Annexes Working Group
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- | | |
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|---|---|

For CSA Z462 and NFPA 70E Arc Flash & Shock training consider affordable, high quality, e-Learning the Electrical Safety Training System (ESTS). Every worker can receive arc flash and shock training, pricing starts at \$125 and can be as low as \$60 per worker. Review a Demo of the ESTS at:

www.arcflash-training.ca
www.eclairdarc.com
ENGLISH & FRENCH AVAILABLE

	Document: ELECTRICAL SAFETY PROGRAM		Subject: Differences CSA Z462, 2 nd Edition to CSA Z462, 3 rd Edition		
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Notes:

- Not all potential changes to CSA Z462, 3rd Edition are presented here. Final changes will depend on final ballot voting of the CSA Z462 Technical Committee.
- You are cautioned to consult the approved CSA Z462, 3rd Edition when it is published in January 2015 prior to making any changes in any safe work practices that are established.
- Written opinions by the authors are personal technical opinions. You are advised to consult the Canadian Standards Association for specific formal interpretation.

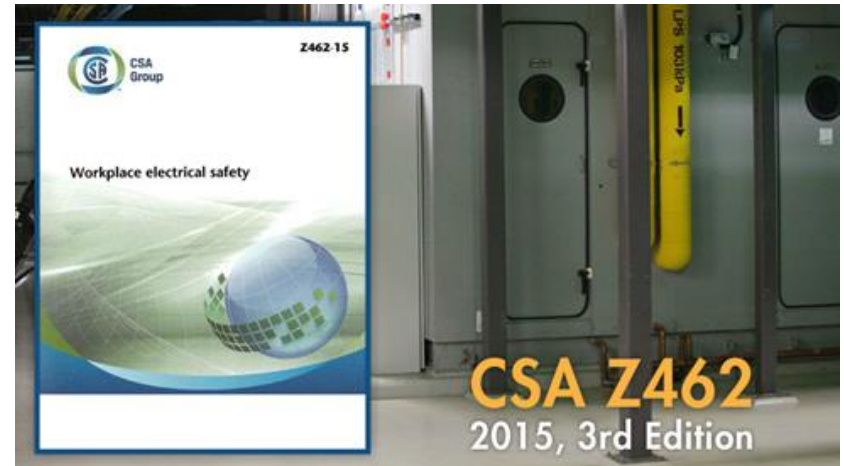
The following list of differences may not be complete, but highlights some of the key differences that you need to review and decide on what revisions may be required to your Electrical Safety Program, supporting Electrical Hazard Analysis Documentation and related Electrical Safe Work Practices and Procedures, etc.

Some key changes are:

1. A major shift has occurred between CSA Z462-12 and CSA Z462-15 with respect to risk assessment for energized electrical work tasks. This further aligns CSA Z462 with other Standards related to Occupational Health & Safety, CSA Z1000 Occupational health and safety Standard and CSA Z1002 (published in 2012) Occupational health and safety – Hazard identification and elimination and risk assessment and control.
2. The requirements to establish an Electrical Safety Program were moved forward in Clause 4, Clause 4.1 to place emphasis on the requirement of the importance of creating and applying an Electrical Safety Program as a priority. The Electrical Safety Program has also been identified to be implemented as part of the employers overall Occupational health and safety management system (OHSMS) integrated or as a stand alone document that works with the overall OHSMS.
3. The Electrical Safety Program developed must now include content that considers the condition of the electrical power distribution equipment and the need for maintenance which aligns with the new CSA Z483 Guideline on maintenance of electrical systems published in 1st Edition in early 2014.
4. New definitions added to clarify the difference between hazard and risk and risk assessment, Clause 3: Hazard, Hazardous, Risk and Risk Assessment. Changes occurred throughout the Clauses and Annexes to ensure consistency.
5. A key change is a broader inclusion of the concept or "Risk Assessment" related to energized electrical work task. To this end significant changes are the addition of new terms or processes:
 - a. Hazard identification changed to Risk Assessment Procedure
 - b. Arc Flash Hazard Analysis now changed to Arc Flash Risk Assessment
 - c. Shock Hazard Analysis not changed to Shock Risk Assessment

CSA Z462 Overview

- 3rd Edition
- 4th Edition work started
- No OH&S Regulations formally reference
- The most successful OH&S Standard ever published by the CSA
- Harmonized with the NFPA 70E



	2021
	2018
2015	
2012	
2008	

Changes & Updates Overview

- Clause order restructured to align with CSA Z1000 OHSMS Standard
- Further alignment with CSA Z1002, Annex F brought forward for global changes
- New Definitions added to clarify the difference of hazard and risk and risk assessment
- Broader inclusion of “Risk Assessment” as related to energized electrical work

Global Changes



Hazard identification
changed to **Risk Assessment Procedure**

Arc Flash Hazard Analysis
changed to **Arc Flash Risk Assessment**

Shock Hazard Analysis
changed to **Shock Risk Assessment**

Deletions

- Hazard/Risk Category Tables, entire selection method and related terminology has been eliminated.
- Hazard/Risk Category 0, new Arc Flash PPE Category starts at Category 1.
- Prohibited Approach Boundary, recognized as being redundant to the Restricted Approach Boundary e.g. shock PPE, tools & equipment requirements.

New Philosophy

“Normal Operation” vs “Abnormal Operation”
of energized electrical equipment.

Normal conditions are assessed as:

- The equipment is properly installed;
- The equipment is properly maintained;
- All equipment doors are close and secured;
- All equipment covers are in place and secured;
- There is no evidence of impending failure.

New Table Method

New Category Method for the selection of Arc Flash PPE.

Used within the context of a Risk Assessment.

1. Determine if Arc Flash PPE is required.
2. Determine the Arc Flash PPE Category.
3. Select & Deploy appropriate PPE.

New Table Method Example 1-2-3

Normal Operation
of a circuit
breaker, switch,
contactor or
starter.

**Typically NO
Arc Flash PPE
is Required**



New Table Method Example – Step 1

Identification using CSA Z462-2015 Table 4A

Task	Equipment condition (2)	Arc flash PPE required (1)
Reading a panel meter while operating a meter switch	Any	No
Normal operation of a circuit breaker (CB), switch, contactor or starter	All of the following: <ul style="list-style-type: none">• the equipment is properly installed;• the equipment is properly maintained;• all equipment doors are closed and secured;• all equipment covers are in place and secured;and• there is no evidence of impending failure.	No
	One or more of the following: <ul style="list-style-type: none">• the equipment is not properly installed;• the equipment is not properly maintained;• equipment doors are open or not secured;• equipment covers are off or not secured; or• there is evidence of impending failure.	Yes

New Table Method Example – Step 2

Arc Flash PPE Category, Table 4B

Equipment	Arc flash PPE category	Arc flash boundary
Panelboards or other equipment rated 240 V and below Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	1	485 mm (19 in)
Panelboards or other equipment rated > 240 V and up to 600 V Parameters: Maximum of 25 kA short-circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	2	900 mm (3 ft)
600 V class motor control centers (MCCs) Parameters: Maximum of 65 kA short-circuit current available; maximum of 0.03 s (2 cycles) fault clearing time; working distance 455 mm (18 in)	2	1.5 m (5 ft)

New Table Method Example – Step 3

Select & Deploy appropriate PPE using Table 5

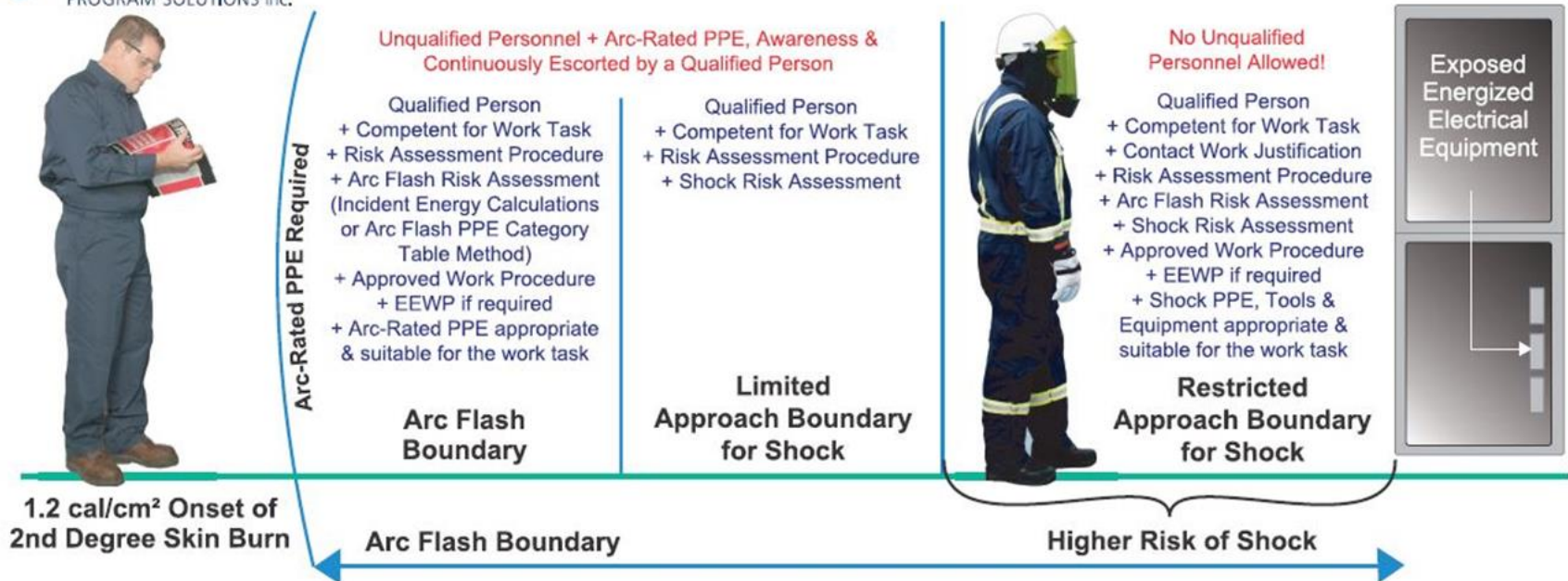
Arc flash PPE category	PPE
1	<p>Arc-rated clothing, minimum arc rating of 4 cal/cm² (Note 3):</p> <p>Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated faceshield or arc flash suit hood (Note 2) Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective equipment:</p> <p>Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (AN) (Note 1) Leather footwear (AN)</p>
2	<p>Arc-rated clothing, minimum arc rating of 8 cal/cm² (Note 3):</p> <p>Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated arc flash suit hood; or arc-rated faceshield (Note 2) and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective equipment:</p>

Arc Flash & Shock Boundaries



Boundaries for Arc Flash and Shock - Approach Limits

Based on CSA Z462-2015 and NFPA 70E-2015 Standard Editions



New Label Requirements



WARNING

Arc Flash & Shock Hazard

ARC FLASH PROTECTION

Working Distance	24 inches
Incident Energy	36.0 cal/cm ²
Arc Flash Boundary	43 inches
ARMS Switch ON	7.8 cal/cm ²
<i>Refer to company's Electrical Safety Program for PPE requirements.</i>	
Location: MCC #1 Building, SWGR #1	

SHOCK PROTECTION

Shock Hazard when covers removed	600 VAC
Limited Approach	42 inches
Restricted Approach	12 inches
Prohibited Approach	1 inch
Rubber Insulating Glove Class	0

Equipment: LOAD Side of FB-1

Study Date: 01/26/2012

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Employer Impacts

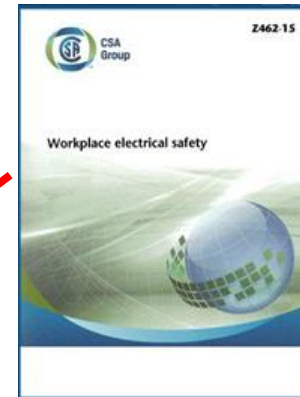
- Updates are required for your Electrical Safety Program.
- Increased emphasis on the importance of an Electrical Safety Program and its application.
- Requirement to implement your Electrical Safety Program as part of your OHSMS.
- Electrical Safety Program must now include content that considers condition of equipment and the need for maintenance (CSA Z463).

Example Inputs/Outputs

Electrical Safety Program

 WARNING	
Arc Flash and Shock Hazard	
Appropriate PPE Required	
FLASH PROTECTION	SHOCK PROTECTION
Flash Hazard at: 18 inches	Shock Hazard when cover is removed: 600 VAC
Flash Hazard Rating: 5.0 cal/cm ²	Limited Approach: 42 inch
Flash Prot. Boundary: 43 inch	Restricted Approach: 12 inch
Glove Class: 0	Prohibited Approach: 1 inch
Clothing Category: #2	
Cotton underwear plus FR shirt and FR pants	
Equipment Name: MCC#3	
February 5, 2008. Std IEEE 1584	
Arc Flash Study by: XYZ Consulting	
File: "ABC PLANT Rev X.xyz"	

Risk Assessment



Forms
Procedures
Workflow



Training



Contractors

2015 Change Management

Step-by-Step Action Plan

- 1) Complete a Gap Analysis, current vs. new.
- 2) Update existing Electrical Safety Program (ESP).
- 3) Review Arc Flash & Shock PPE.
- 4) Train workers on the updated CSA Z462-2015.
- 5) Train workers on your updated ESP.
- 6) Full internal or external electrical safety audit.

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Who Needs Training?

Electrical Worker vs. Non-Electrical Worker



Who can perform Routine Operations?

Only Workers who are Knowledgeable and Competent having been trained and demonstrated the ability to assess **Normal versus Abnormal** equipment conditions.



Training Lesson Example

Learning how to assess **Normal** versus **Abnormal** equipment conditions.



2015 Training Formats

eLearning



Instructor-led



Blended Learning

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Coveralls Designed for Electricians

- Traditional Arc Flash Coveralls were designed to accommodate for several underlayers (Uniform)
- Arc Flash Suit design elements incorporated into new Electrical & Instrumentation coverall design
 - Continuous Zipper
 - Non-Conductive Closures
 - Additional Pockets
 - CSA Z96 HVSA



Ultra Lightweight Suits



- Lighter weight fabrics allow for mobility and increased worker productivity
- Functional designs for optimal worker safety
- Comfort options to reduce heat stress
 - Arc-Rated Cooling Vest
 - Ventilation Systems

Grey vs. Green

CALL FOR NOMINATIONS
Visit cos-mag.com/safety-leader.html for nomination details.



**2015
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The nationwide search for the outstanding safety professional. *Canadian Occupational Safety* accepting nominations for the Safety Leader of the Year.

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**NOMINATIONS
JULY 6, 2015**

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**NOMINATIONS
JULY 6, 2015**

Beware of Myths vs. Realities

- “Safe” PPE does exist above 40 cal/cm²
- 40 cal/cm² is **NOT** the limit
- Arc Flash suits are available with protection up to 140 cal/cm²
- Blast Pressure is not related to Incident Energy!



Beware of PPE Pitfalls



Long Coat Suit Design
protection concern and
was not designed for
Electrical Workers.

Arc Flash “clothing shall cover potentially exposed areas as completely as possible.... shall be closed at the neck.”



Not all PPE is Created Equally



Before

After



Free PPE Resources

Unlimited PPE Website Library

OBERON Arc Flash Suit Technical Specification

INOEXIER
TCG
True Colour Grey
Arc Protection



Oberon Model	ARC40	ARC65	ARC100
Arc Rating (ATPV)	42 cal/cm ²	67 cal/cm ²	106 cal/cm ²
Fabric Weight	10.7 oz/yd ²	13.3 oz/yd ²	18 oz/yd ²
Protection per Ounce	3.93	5.04	5.89
Fabric Colour	Green	Tan	Yellow
True Colour Grey Hood	ARC40G-CC	ARC65G-CC	ARC100G-CC
Add Ventilation & LED Lamp	+HVSL	+HVSL	+HVSL
Hood, Coat & Bib-Overall	IFR4GB-Size+HVSL	IFR5GB-Size+HVSL	IFR6GB-Size+HVSL
Budget Price per Suit (M-XL)	\$1,380	\$1,500	\$1,740

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OBERON ARCSHIELD
Technical Users Guide

OBERON

Technical User Guide for Oberon ArcShield Faceshields
Applicable for all Standard and Deluxe Models



Table of Contents

Technical Specifications & Requirements 2

Recommendations 2

ASTM F1506-10a Performance Standard

PPE Selection Advice;
If the garment states compliance with ASTM F1506-10a but the label is not correct, buyer beware!



ASTM F1506-10a

6.3 Garments shall be labeled with the following information:

6.3.1 Tracking identification code system,

6.3.2 Meets requirement of Performance Specification F1506,

6.3.3 Manufacturer's name,

6.4 Size and other associated standard labeling,

6.3.5 Care instructions and fiber contents, and

6.3.6 Arc rating (ATPV) or arc rating (E_{arc}.)

OBERON
Electrical Specific PPE Audit

Company Name _____

Department _____

PPE Decision Maker _____

City _____

Province _____

Phone Number _____

Number of Workers exposed to Electrical Hazards (Require PPE): _____

Safety Standard selected: CAN/ULC S801

CSA Z462

Hazard Analysis Method used: Incident Energy (cal/cm²)

Tables (H/R Category): _____

PPE Audit Criteria

Types of Arc Flash PPE	Electrical Specific PPE currently in use		
	Arc Flash Suits	Daily Wear	Shields
Arc Rating (ATPV)			
Head Protection (Type of Hood?)			
Upper Body (Coat, Coveralls, etc)			
Lower Body (Bib-Overalls, etc)			

OBERON
Division of Panenbourg Corp.

WHY NOT FLAME RETARDANT TREATED COTTON?


One of the products used for flame resistant clothing is flame retardant treated cotton (FRT cotton). Recently, single layer and multiple layer arc flash suits have been introduced which consist solely of FRT cotton. Below are several important factors which need consideration prior to selection of arc flash suits fabricated with FRT cotton.

- ✓ **Garment Weight and Wearer Comfort:** The weight of an arc flash suit typically increases by over 50% when constructed of FRT cotton versus inherently flame resistant materials like Kevlar, Nomex, PBI, Basofil or Carhtex materials. Heavy garments become a significant concern for higher Arc Ratings. These heavier FRT cotton arc flash suits feel also more stiff and bulky than lighter inherently flame resistant arc flash suits, and consequently worker mobility and productivity are diminished.
- ✓ **Garment Durability:** In spite of the heavier fabric weights, the typical garment life of an FRT cotton garment is about half that of a flash suit constructed of inherently flame resistant fabrics.
- ✓ **Laundering Limitations:** FRT cotton can lose its flame retardant when bleached with chlorine or hydrogen peroxide. If the flame retardant is lost, the FRT cotton becomes flammable cotton garment. Another related issue is that if the flame retardant is lost, the appearance of the FRT cotton remains the same, i.e., there is not a visual indication that the FRT cotton has become flammable. Full control of laundering and a periodic testing program become crucial for users of FRT cotton garments. Bleaching is also not recommended for inherent FR materials, but this is due to a potential loss of durability rather than a loss of flame resistance.
- ✓ **Exothermic Reaction:** FRT cotton is protective up to the point where the chemistry flame retardant system "activates" when the fibers begin to ignite. When this occurs, there is a chemical reaction which causes the FRT cotton fabric to "self-extinguish". This is

FREQUENTLY ASKED QUESTIONS

I Know the Voltage,
What Arc Suit Should I get???

Voltage Does Not Determine Hazard Category Levels !



Knowing the voltage is only one piece of determining Arc Flash PPE. The available fault current (amps), the working distance between the worker and the equipment, the clearing time of the circuit protection device, the spacing between conductors or from a conductor to ground, the number of phases, whether the conductors are in an enclosure, and the equipment configuration are also needed to determining the potential Arc Flash exposure level and the required PPE.

NFPA 70E Table 130.7(C)(9)(a) is organized by system voltage level, but at each voltage or range of voltages, there are several different levels of PPE based on the type of task and the equipment as well as on footnote information for fault current and clearing time. For example, a 480-volt system could have a required level of protection from 1 to 4 based on the task.

Contact Information

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Questions & Answers

