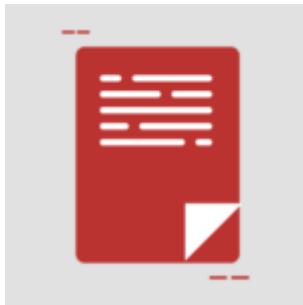# Are You Doing Enough to Protect Workers from Arc Flash Hazards?

Managing arc flash hazards is a serious compliance challenge. In addition to [OHS electrical safety regulations](), OHS coordinators must navigate provincial electrical codes, as well as non-government standards like:

- The [*Canadian Electrical Code*](), a national safety standard containing over 900 pages of safety requirements for installation, operation and servicing of electrical equipment.
- Provincial electrical codes and regulations.
- [NFPA 70E](), a U.S. standard prescribing measures for protecting workers against electrical shock, arc flash, and arc blast.
- [CSA Z462](), a Canadian version of NFPA 70E designed for uniquely Canadian conditions.

Here's a quick briefing of the 6 things you should be doing to safeguard your workers against the dangers of arc flash.

What Is Arc Flash

Working with or near energized electrical equipment poses 2 kinds of hazards: electrical shock and [arc flash](). Although shock causes the most injuries, arc flash is the hazard workers fear the most. And for good reason. Arc flash, which

occurs in just a few milliseconds when electrical energy passes through air from a high voltage down to a low voltage (usually ground) conductor, causing extreme heat and a blinding flash of light that may ignite a fire or explosion producing temperatures in the order of 35,000° C, blast pressure equivalent to a large jetliner at full throttle and flying shrapnel like a grenade.

1. **Determine Approach Boundary**

In planning a job that involves working on or near energized equipment, you must have a qualified person assess both electrical shock and arc flash hazards. The shock hazard assessment evaluates the likelihood and severity of injury from electrical shock. Using the assessment findings, the qualified person should mark out an approach boundary limiting how close certain workers can get to the equipment. There are 2 basic types of approach boundaries:

- **A limited approach boundary** is the distance that a person wearing appropriate PPE and who's being supervised by a qualified person may approach an exposed energized electrical conductor or circuit part.

- **A restricted approach boundary** is the distance from an exposed energized electrical conductor or circuit part a qualified person (and only a qualified person) may approach when there's an increased likelihood of electric shock due to electrical arc.

Unqualified workers not using PPE and not under a qualified person's supervision must stay outside the boundary at all times.

2. **Determine Arc Flash Boundary**

Before workers work on or near exposed energized electrical equipment, a qualified person must also perform a hazard assessment in accordance with CSA Z462 to identify and

determine how to control arc flash hazards exist. As part of the assessment, the qualified person must perform an incident energy analysis to determine the incident energy exposure of the worker in calories per square centimetre.

Using the results of both assessments, the qualified person must determine what's called the arc flash boundary, or distance workers and equipment must maintain from the energized electrical equipment to avoid secondary degree burns, more precisely, the distance at which the incident energy equals 5 Joules/cm2(1.2 calories/cm2).

3. **Determine Appropriate PPE for Arc Flash**

You must ensure workers exposed to arc flash and shock hazards use the right PPE. Workers must know how to select, use, and care for the necessary PPE, and understand the limitations of the PPE. CSA Z462 specifies 2 methods that you can use to determine what type of PPE to use for different tasks posing arc flash hazards.

Method 1. Incident Energy Analysis

Incident energy is a measure of the thermal energy that an arc flash would generate based on the distance between the source and a worker's face and chest. The closer the worker is to the source, the greater the thermal energy released and the greater the protection required.

Method 2. Arc Flash PPE Category

The other option is to select PPE and protective clothing based on the task to be performed using the using the table contained in CSA Z462 that lists 5 categories of arc flash PPE delineated according to the risk associated with different tasks based on working distance and incident energy:

Arc Flash PPE Category* (from lowest to highest level of protection)	Minimum Arc Rating (measured in calories/cm2)
Category 1	≥ 4
Category 2	≥ 8
Category 3	≥ 25
Category 4	≥ 40
Category 5	≥ 75

* The revised version of the Standard, CSA 462-2024, bases PPE selection directly on arc ratings rather than categories. Example: PPE previously referred to as "Category 1" is now referred to as PPE with an arc rating of at least 4 cal/cm².

4. Determine Appropriate Protective Clothing for Arc Flash

Each of the CSA Z462 Standard's Arc Flash PPE categories has suggested flame-resistant (FR) garments and garment systems, as well as a minimum arc rating (AR) for the garment system.

Arc Flash PPE Category*	Typical Equipment
Category 1	FR shirt and pants or FR coveralls.
Category 2	FR clothing, including FR pants and shirt or FR coveralls plus AR face shield and balaclava or arc flash suit hood.
Category 3	Arc flash suit jacket, pants, and hood plus appropriate gloves and other accessories.
Category 4	Complete arc flash suit including jacket, pants, and hood with additional layers as necessary for higher protection.
Category 5	Complete arc flash suit including jacket, pants, and hood with additional layers as necessary for higher protection.

* The revised version of the Standard, CSA 462-2024, bases PPE

selection directly on arc ratings rather than categories. Example: PPE previously referred to as "Category 1" is now referred to as PPE with an arc rating of at least 4 cal/cm².

CSA 462-2024 includes additional guidance on proper use of equipment, garments and underlayers:

- Non-AR underlayers may be worn under AR PPE, as long as the PPE system's arc rating is sufficient to prevent breakopen of the innermost AR layer at the expected incident energy level—otherwise the non-AR layers may ignite;
- Non-AR garments may not be used to increase the arc rating of the garment system;
- Meltable fibres such as polyester and polypropylene must not be used in underlayers, but undergarments and socks can contain incidental amounts of elastic;
- AR layers may also contain some amount of meltable fibres, as long as the fabrics meet ASTM F1506 or ASTM F1891;
- PPE must be worn as intended, with zippers fully zipped, cuffs buttoned and shirts tucked in;
- Tight-fitting clothing that reduces the protective air gap between PPE and the body should be avoided; and
- Garments must provide necessary protection and not interfere with tasks.

5. **Determine Need for Additional PPE**

Require personnel within the arc flash and approach boundaries to wear any additional PPE necessary, which might include:

- Protective headwear meeting the most current version of CSA Z94.1, i.e., i. Type 2, Class 'E' (Electrical): rated for 20,000 volts; or ii. Type 2, Class 'G' (General): rated for 2,200 volts. (**Note:** Type 2, Class 'C' (Conductive), doesn't offer electrical protection

and shouldn't be used for electrical work).

- Protective eyewear meeting the most current version of CSA Z94.3.
- Rubber insulating gloves that are air (inflation) tested and inspected and that provide protection against the maximum voltage to which workers will be exposed.
- Protective footwear meeting the most current version of CSA Z195.
- Rubber mats, leather aprons and other insulating equipment to protect against shock.

6. **Ensure Electrical Equipment Is Properly Labeled**

There must be a label on the exposed, energized electrical equipment that warns of the danger of arc flash and lists:

- The nominal system voltage.
- The arc flash boundary.
- The required PPE within the arc flash boundary.

Entrances to rooms or areas containing exposed live electrical parts must also have a conspicuous warning sign stating "DANGER — ENERGIZED EQUIPMENT" or "DANGER — HIGH VOLTAGE" and forbidding unauthorized persons to enter.