
# ELECTRICAL Safety Measures

"All electrical incidents are preventable! Keep employees safe with an up to date Electrical Safety Program and appropriate training."

## CSA Z462-2015, Clause 4.3.5

## Arc Flash Risk Assessment & 40 cal/cm$^2$ Myth

**By Terry Becker, P.Eng.**

Qualified Electrical Workers (QEW) need to complete an Arc Flash Risk Assessment related to an energized electrical work task that has been assigned to them. What does this mean? How do they get the hazard information they need? Is there an Equipment Label, is it correct? If there is NO Equipment Label what does the QEW have to do? Does the QEW understand that arc-rated PPE is defined by its Arc Thermal Performance Value (ATPV)? Is the Arc Flash Boundary distance understood? Do the workers keep their face and torso at the "Working Distance" when they perform the work task that may expose them to an arc flash? Does the QEW follow a company's defined policies and practices when performing a work task that may expose them to an arc flash?

As part of a company's Electrical Safety Program it shall outline the requirements for the QEW to complete an Arc Flash Risk Assessment related to an assigned work order, work request or job. It is noted that the job specific Arc Flash Risk Assessment is a component of the overall CSA Z462

Clause 4.1.5.7 Risk Assessment Procedure (RAP) that is used to quantify harm and ensure policies/practices are followed related to the potential exposure to an arc flash and ensure required PPE is worn to reduce the harm. Where it is identified by the QEW that discrete work tasks required to complete a job may expose them to arc flash they must complete an Arc Flash Risk Assessment for each discrete work task. Two methods are available:

1. Arc flash incident energy analysis method; and
2. Arc Flash PPE category method (CSA Z462 Table 4A Arc flash hazard identification AC or DC and determining an Arc Flash PPE Category for the work task).

As outlined in CSA Z462 Clause 4.3.5 Arc flash risk assessment, an Arc Flash Risk Assessment shall be performed for a work task to:

(a) determine if an arc flash hazard exists. If an arc flash hazard exists related to the discrete work task then the risk assessment shall determine (i) appropriate safety-related work practices; (ii) the arc flash boundary; and (iii) the PPE that personnel within the arc flash boundary shall use when performing the work task;

(b) the Arc Flash Risk Assessment shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, at intervals not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the analysis; and

(c) take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

In applying this Clause one of the issues I have discovered in industry when implementing Electrical Safety Programs or completing External Electrical Safety Audits is that companies and their qualified electrical workers, supervisors and electrical engineers have migrated to believing that normally operating energized electrical equipment has a high probability of an arcing fault occurring and arc flash resulting. This is not true.

There is also a belief that "operating" energized electrical equipment that is in a "normal operating" condition has an inherent arcing fault probability. This statement is not true.

To help industry clarify this CSA Z462-2015 Table 4A provides a generic list of work tasks, one of them is "Normal operation of a circuit breaker (CB), switch, contactor or starter." For this task if the equipment condition is "Normal" NO ARC FLASH PPE is required. It is important that the work task assigned to a QEW is analyzed correctly in determining if an arc flash hazard exists.

Work tasks related to diagnostics and troubleshooting, repair and alteration and isolation will expose a QEW to the probability of an arcing fault and arc flash occurring. As an additional note CSA Z462-2015 Clause 4.3.2.2.4 Normal operation further clarifies five (5) conditions that define "Normal Operation":

(a) the equipment is properly installed;
(b) the equipment is properly maintained;
(c) all equipment doors are closed and secured;
(d) all equipment covers are in place and secured; and
(e) there is no evidence of impending failure.

If these conditions are satisfied from a reasonable and practical perspective, then operating energized electrical equipment requires no arc flash PPE.

As identified in Clause 4.3.5 the QEW, after confirming they may be exposed to an arc flash, shall follow appropriate safety-related work practices. These work practices should be documented in a company's Electrical Safety Program and would include policies and practices related to: following the company's "Work Flow Process" to complete necessary documentation before executing the work task; establishing an electrically safe work condition if possible; using an Electrical Safe Work Procedure; managing temporary power; use of an Energized Electrical Work Permit (EEWP) if required; alerting techniques; alertness; blind reaching; illumination; housekeeping; working alone; look-alike equipment; no jewelry policy; requirements for temporary protective grounding; and switching & isolation. Specialized equipment may also require specific procedures to be followed.

If an arc flash hazard exists related to the work task, the QEW shall determine and apply the Arc Flash Boundary. The Arc Flash Boundary distance is a distance at which NO arc flash PPE is required to be worn, the incident energy has been calculated to be 1.2 cal/cm$^2$. Un-qualified and unprotected workers can stand outside the Arc Flash Boundary while the work task is performed and require NO arc flash PPE to be worn. An "Electrical Work Zone" with red "Danger" tape or other barricading shall be established at the Arc Flash

Boundary if its distance is greater than the Limited Approach Boundary for shock.

Lastly, the QEW would: determine from an incident energy analysis performed by a P.Eng. or the results of using the Arc Flash PPE category method, the required arc-rated PPE for the specific work task by identifying its Arc Thermal Performance Value (ATPV); pre-use check and inspect the PPE, and don the arc flash PPE just before executing the work task and ensuring their face and torso are at the defined "Working Distance" when they perform the work task.

Related to the Arc Flash Risk Assessment, some history exists with industry miss applying information provided to them related to the old Hazard/Risk Category (HRC) Table Method, now called the "Arc Flash PPE category Method" in the CSA Z462-2015 Edition. Training and incident energy analysis studies incorrectly identified arc-rated clothing exclusively with an HRC#. This was technically incorrect as all arc-rated clothing is identified with an Arc Thermal Performance Value (ATPV) as required by ASTM F1959.

An additional problem was exposed when engineering consultants included in their reports that an incident energy value of greater than 40 cal/cm$^2$ was "Dangerous" and "No PPE Exists." Both statements are incorrect and equipment labels were installed where Method 1 was used and that wrongly communicated this information to QEWs to be used in their work task Arc Flash Risk Assessment. An example of an equipment label that is technically incorrect is included in Figure 1 below. It is noted that arc flash suits with ATPVs of 71 cal/cm$^2$, 106 cal/cm$^2$ and 140 cal/cm$^2$ are available and protect to the same level as 8 cal/cm$^2$ arc-rated PPE.

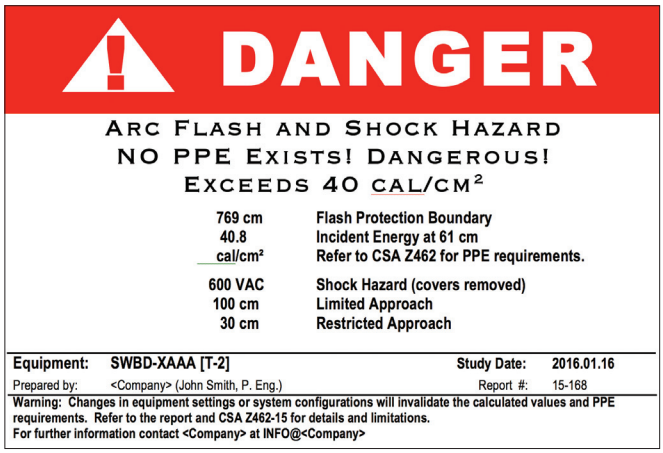


***Figure 1.*** *Incorrect Danger Equipment Label*

Historically there has been confusion related to the Arc Flash Risk Assessment and what I call the "40 cal/cm$^2$ Myth." Arc blast pressure related to an arc flash has been incorrectly linked to a 40 cal/cm$^2$ incident energy value when it shouldn't be. Arc blast pressure doesn't directly correlate to incident energy and 40 cal/cm$^2$ of incident energy is not a "Dangerous" incident energy level. Incident energy greater than 1.2 cal/cm$^2$ is "Dangerous" when no arc-rated PPE is worn as the clothing may ignite leading to a significant burn injury. Arc blast pressure actually pushes the QEW away from the arcing fault location and yes may cause physical trauma. There is no documented evidence of a fatality directly linked to arc blast pressure in the last 20 years.

So as a component of the CSA Z462-15 Risk Assessment Procedure, an Arc Flash Risk Assessment is required to be completed if a Qualified Electrical Worker will be exposed to an arc flash. CSA Z462-2015 outlines the requirements. The Arc Flash Risk Assessment when performed will be used in the work task's Risk Assessment Procedure to have a positive impact on consequence or harm, and when policies and practices are established the likelihood of occurrence is also positively impacted. This results in the Risk Level of the work task to be acceptable and the work task can be executed by the Qualified Electrical Worker.

Please submit any questions or comments you may have to Kevin Buhr and myself at kevinb@electricalline.com and terry.becker@esps.ca.

***Terry Becker****, P.Eng., CESCP, IEEE Senior Member is the first past Vice-Chair of the CSA Z462 Workplace electrical safety Standard and currently a Voting Member and Working Group 8 Leader, Annexes. He is also a Voting Member on the IEEE 1584 Technical Committee and an Associate Member of the CSA Z463 Guideline on maintenance of electrical systems. Terry is a Professional Engineer in the Provinces of BC, AB, SK and ON. Terry is the President & Owner of ESPS Electrical Safety Program Solutions INC., an electrical engineering consulting firm specializing in electrical safety consulting, licensed products and training solutions.* ***www.esps.ca***