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Safety Measures ^{ELECTRICAL}

“Elimination is the first priority!
Ensure a risk assessment is completed before energized work tasks are completed.”

CSA Z462 Clause 4.3.7.3.15 Arc Flash PPE Category Method – How Do I Use It?

By Terry Becker, P.Eng., CESC, IEEE Senior Member

With all of the attention on the new 2018 Edition of IEEE 1584 Guide for Performing Arc-Flash Hazard Calculations, I thought it would be appropriate to ensure that industry understands that the CSA Z462 Workplace electrical safety Standard, 2018 Edition includes two methods to determine “additional protective measures” when an Arc Flash Risk Assessment is completed for an energized electrical work task.

I am concerned as well that a lot of the “arc flash” and “arc flash awareness” training out there may not communicate and train on this method properly.

The 2018 Edition of CSA Z462’s Arc Flash Risk Assessment process is significantly different than previous additions. A true

risk assessment process is required to be followed first and then determine arc flash PPE, the working distance, the arc flash boundary distance and appropriate safety related work practices to apply to the energized electrical work task in order to reduce risk. This process is also completely separate from the requirement for an Energized Electrical Work Permit (EEWP).

How Do I Use the Arc Flash PPE Category Method?

In CSA Z462 Clause 4.3.5 Arc Flash Risk Assessment is where you need to start. An arc flash risk assessment requires three initial steps to be completed:

1. Identify if an arc flash hazard exposure exists for the

- work task description;
2. Estimate the likelihood of occurrence of injury or damage to health and the potential severity of injury or damage to health; and
 3. Determine if additional protective measures are required if you cannot eliminate exposure, including the use of PPE, to reduce risk to as low as reasonably practicable.

Start by identifying the work task(s) description(s) to complete an assigned Job and if you will be exposed to an arcing fault and arc flash hazard. Associated with the work task description ensure the maximum voltage level of exposure is established, this is required to verify arcing fault sustainability and make the correct row selection in CSA Z462 Table 6A. The following exemptions would apply where an arcing fault cannot be sustained:

- A. Voltage is less than 30V.
- B. Electrical equipment is 120/240VAC single phase power or control.
- C. Electrical equipment is 208VAC three phase and sourced from a transformer that is 30kVA or less.
- D. 12VDC, 24VDC, 48VDC or 125VDC control power.

You then reference the new CSA Z462 Table 2 Estimate of the likelihood of occurrence of an arc flash incident for AC and DC systems as the next step. Some of the work task descriptions do not indicate the voltage so you need to reference the exemptions above.

CSA Z462 Table 2 will advise you of the likelihood of occurrence of an arcing fault and arc flash for the listed work task description as “YES” or “NO” based on an assessment of the condition of maintenance of the electrical equipment that the work task will be performed on as “ANY, NORMAL or ABNORMAL.”

With respect to risk assessment and likelihood of occurrence you need to be qualified & competent to perform the work task(s) and need to manage your human performance to control the probability of error. Ensure the work area is clean and you can egress the work area if required.

If CSA Z462 Table 2 indicates “YES” then “additional protective measures” shall be determined to reduce risk. As a component of the determined “additional protective measures” you will determine what full body arc flash PPE you require to wear in order to effectively manage potential severity of injury or damage to health when executing the energized electrical work task(s).

As mentioned above the employer can proactively have arc flash hazard calculations completed for 208V to 15kV electrical

equipment using the IEEE 1584 formulas by a P.Eng. Electrical Engineer and a P.Eng. stamped report issued and the arc flash hazard data included on an Arc Flash & Shock Equipment Label that would be labeled on electrical equipment and used by a Qualified Electrical Worker to determine “additional protective measures.” If these calculations are not completed then CSA Z462 provides the Arc Flash PPE Category Method to determine “additional protective measures.” You use CSA Z462 Table 6A, 6B and 6C after referencing CSA Z462 Table 2.

Here is a more detailed procedure to follow when using the CSA Z462 Arc Flash PPE Category Method.

1. Follow a Work Flow process for your company. Jobs are assigned to Qualified Electrical Workers planned or reactive (unscheduled). A Work Order is issued.
2. After the Job is assigned identify the discrete energized work task(s) that will be required to be executed in order to complete the Job. For example, troubleshooting a 600VAC, 20hp motor starter that operations has called and advises they cannot get the motor to start.
3. Before you leave the maintenance shop you already know that you will have to:
 - a) Identify the motor and motor starter, use a single line diagram. Inspect the electrical equipment, any visible signs of an abnormal condition? You may attempt to start the motor using an On/Off or Hand-Off-Auto switch.
 - b) You will return to the Electrical Room or location where the MCC is located. You will have to isolate the motor starter by opening the circuit breaker with the MCC starter bucket door closed.
 - c) You will need to open the hinged door on the motor starter bucket.
 - d) You will complete a visual inspection of the inside of the motor starter.
 - e) You will need to use your test instrument (e.g. DMM) to test for voltage on power and control circuits and circuit parts to complete diagnostics/troubleshooting to determine why the motor will not start.
4. In Item 3. above several of the discrete work tasks listed may expose you to arc flash and/or shock hazards. Each work task has to be assessed individually. Besides completing an Arc Flash Risk Assessment, you will also have to complete a Shock Risk Assessment for the work task descriptions.
5. For arc flash you now reference CSA Z462 Table 2 and locate the work task description(s). The seventh work task described as “For AC systems, work on energized electrical conductors and circuit parts, including voltage testing” is selected and used. It indicates that for Equipment Condition “ANY” and likelihood of occurrence as “YES.”

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Table 1 – Example of Maximum Available Fault Current

Secondary Voltage of Transformer (3 Phase)	Transformer kVA	%Z	Maximum Available Fault Current
208V	300 kVA	4%	20.9 kA
480V	2000 kVA	5%	48.2 kA
600V	2500 kVA	5%	48.2 kA
4160V	10000 kVA	4%	34.7 kA

Table 2 – Protective Devices Maximum Fault Clearing Time

Protective Device	Maximum Fault Clearing Time (Total Opening Time)
208/480/600V Molded Case Circuit Breaker	1.5 cycle instantaneous integral trip
480/600V Insulated Case Circuit Breaker	20.0 cycle with a short time fault clearing delay
1kV to 35kV Power Circuit Breaker, Relay Operated	5.0 cycle instantaneous range, not intentional delay

6. Based on an assessment of “condition of maintenance” as ANY, NORMAL or ABNORMAL the likelihood of occurrence of an arcing fault and arc flash is indicated as YES or NO. In CSA Z462 Table 2 opening the hinged door and completing the voltage measurements would be indicated as “YES” for “ANY” equipment condition.
7. If the indication of likelihood of occurrence is “YES” you will need to determine “additional protective measures.” See CSA Z462 Clause 4.3.5.3. This includes determining appropriate safety related work practices (following your company’s Electrical Safety Program and it’s Work Flow you may need to fill out an Field Level Hazard Assessment (FLHA) at the location the work task(s) will be performed at, complete and document a Job Safety Plan, and follow specific policies such as when you can work alone, you may need to use a procedure, etc.), the arc flash boundary distance and the arc flash PPE you will be required to wear when an arcing fault occurring is likely and you are inside the arc flash boundary distance. FYI, the arc flash boundary distance is only real at the point in time when the work task been completed could result in an arcing fault been created or occurring.
8. Using the Arc Flash PPE Category Method for AC work tasks reference CSA Z462 Table 6A “Arc-flash PPE categories for alternating current.”
9. Identify the electrical equipment description and voltage level that applies to your Job in Table 6A that the work task will be performed on.
10. Confirm that for the electrical equipment you will be working on you comply with the parameters listed for maximum available fault current and maximum fault clearing time.
11. To determine the maximum available fault current, you must confirm the transformer kVA and %Z or for a generator the kW rating and X"d. Calculate or reference a look up table for the maximum available fault current that the transformer or generator could deliver (Table 1).
12. With respect to the maximum available fault current CSA Z462 Table 6A in the notes advises of typical electrical protective devices typical opening times e.g. molded case circuit breaker in branch circuit application 1.5 cycles (Table 2).
13. After you confirm that you comply with the parameters, you can use the Arc Flash PPE Category # in the Table 6A row to determine the arc-rated PPE you will have to wear to execute the energized electrical work task. The row in Table 6A also lists the working distance to apply and the arc flash boundary distance that applies to the work task.
14. Go to CSA Z462 Table 6C Personal protective equipment (PPE) and convert the Arc Flash PPE Category # that you determined from Table 6A to a minimum Arc Thermal Performance Value (ATPV) rating of arc flash PPE.
15. Pre-use check and inspect the arc flash PPE before you don it and apply it to the energized electrical work task(s). Rubber insulating gloves with leather protectors provide arc flash protection for the hands.

The above procedure is a step by step process to use the CSA Z462 Arc Flash PPE Category Method. Typical data is assumed for protective device fault clearing times. Condition of maintenance has to be assessed by the Qualified Electrical Worker and normal operating conditions confirmed.

Terry Becker, P.Eng, CEMCP, IEEE Senior Member is the first past Vice-Chair of the CSA Z462 Workplace electrical safety Standard Technical Committee and currently a Voting Member and Working Group Leader for Clause 4.1 and the Annexes. Terry is also a Voting Member on the CSA Z463 Maintenance of electrical systems Standard and a Voting Member of the IEEE 1584 Guideline for Arc Flash Hazard Calculations. Terry has presented at Conferences and Workshops on electrical safety in Canada, the USA, India and Australia. Terry is a Professional Engineer in the Provinces of BC, AB, SK, MN and ON. Terry is an Electrical Safety Specialist, Management Consultant, and can be reached at 587.433.3777 or by email terry.becker@twbesc.ca.