



# WORKING WITH CAPACITORS – ARC FLASH & ELECTRIC SHOCK

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**TW BECKER**  
ELECTRICAL SAFETY CONSULTING

## ELECTRICAL SAFETY BULLETIN

With the addition of NFPA 70E, Chapter 3, Article 360 Safety-Related Requirements for Capacitors (2021 Edition) and NFPA 70E Annex R Working With Capacitors and new CSA Z462 Clause 6, Clause 6.7 Safety-related requirements for capacitors and new CSA Z462 Annex W Working with capacitors it is extremely important that new electrical hazard classification information and boundaries **that ONLY APPLY to CAPACITORS** are not confused with abnormal arcing fault and arc flash for other low and high voltage ac or dc electrical equipment.

With respect to bonding, grounding and temporary protective grounding (for high voltage electrical equipment) there are new “grounding” terms specific to capacitors, care needs to be taken to not confuse these definitions and their specific application. Both NFPA 70E in Article 100 and CSA Z462 in Clause 3 identify definitions that relate only to capacitors.

Ensure ac and dc electrical equipment arcing faults and arc blast pressure are not confused with the term “arc blast pressure” associated specifically with capacitors and the definition of a “hearing protection boundary” and “lung protection boundary.”

Within NFPA 70E Article 360 and CSA Z462 Clause 6.7 the specific voltages and energy levels of capacitors identified when determining arcing fault and arc flash must be considered. See notes to Table 1 below.

Electric shock related to capacitors is also uniquely identified and information is available in NFPA 70E Annex R and CSA Z462 Annex W.

The table below summarizes the boundaries and the application.

**Table 1 – NFPA 70E & CSA Z462 Capacitor Boundaries Reference**

Low & High Voltage Electrical Equipment Arc Flash	Low & High Voltage Electrical Equipment Including Capacitors (exposed conductors and circuit parts)	Capacitors <sup>1</sup>	Comments Related to Capacitors <sup>2</sup>
Arc Flash Boundary	Limited Approach Boundary	Arc Flash Boundary	When an arc flash hazard exists, an approach limit from an arc source at which incident energy equals 1.2 cal/cm <sup>2</sup> (5 J/cm <sup>2</sup> ).
Arc Blast Pressure. Arc flash, arc blast pressure results when the abnormal arcing fault occurs, expanding air. Arc blast pressure is based on arcing fault current, NOT incident energy.	Restricted Approach Boundary	Arc Blast Hazard	A source of possible injury or damage to health from energy deposited into acoustical shock wave and high-velocity shrapnel (reference 70E, Article 360, Z462, Clause 6.7).
		Lung Protection Boundary <sup>3</sup>	Worker distance at which a 1 percent probability of lung damage exists from a 70kPa (10 psi) shock wave.
		Hearing Protection Boundary <sup>3</sup>	Working distance at which a 1 percent probability of ear damage exists from a 20kPa (3.0 psi) shock wave.

**Notes:**

1. Reference NFPA 70E, Chapter 1, Article 100 Definitions and CSA Z462, Clause 3 Definitions (new definitions when available). The definitions identify their applicability as noted.
2. An electric shock received from capacitors will be different than a normal ac or dc shock. Shockwave. Reference Annex R of NFPA 70E and Annex W of CSA Z462.
3. Reference NFPA 70E Annex R or CSA Z462 Annex W, Working With Capacitors. Separate formulas are provided for incident energy, the arc flash boundary, lung protection boundary and hearing protection boundary and will be included in available power system software.
4. Do not mix the capacitor boundaries with other low or how voltage electrical equipment when

- completing a work task's arc flash risk assessment.
5. From NFPA 70E, Article 360 and CSA Z462 Clause 6.7 "appropriate controls shall be applied where any of the following hazards thresholds are exceeded."
    - a. <100V and > 100J of stored energy.
    - b. ≥100V and > 1.0J of stored energy.
    - c. ≥400V and > 0.25J of stored energy.
  6. Limits of Approach/Minimum Approach distances for overhead high voltage exposed electrical equipment is defined by OSHA Regulations in the USA and Provincial, Territorial or Federal OH&S Regulations in Canada.

## RELEVANT RESOURCES

### FREE DOWNLOADS

<https://twbesc.ca/esp-free-tools>

## CONTACT



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