SAFETY STARTS WITH ME

NFPA 70E 2024

Updates

NFPA 70E Changes

Document Changes

Minor changes to wording but the intent did not change.

NFPA continued reorganizing the sections without change to intent

Document Changes

Article 90.3 explains Workplaces Covered and Not Covered

As with NFPA 70 the National Electrical Code (NEC), definitions have been moved to Article 100. Or simply deleted. For example, in the 2021 revision section 340.2 defined “radiation worker”. The 2024 revision does not have this definition in Article 100 or in Article 340.

There’s greater consistency of structure. In the 2021 revision, many articles omitted a statement of scope. Now every article has a statement of scope, and its always Sec. 1. For example, Sec. 300.1 provides the statement of scope for Art. 300.

Document Changes

Article 100. Now instead of a short definition for “Hazard” you encounter slightly more detailed definitions of “Electric shock hazard” and of “electrical hazard”.

Hazard, Electric Shock (Electric Shock Hazard) – A source of possible injury or damage to health associated with current through the body caused by contact or approach to exposed energized electrical conductors or circuit parts.

Hazard, Electrical (Electric Hazard) – A dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or arc blast injury.

Document Changes

In the 2021 revision, the word “shock” was used to mean “electrical shock”. The 2024 version uses both words. This may strike many as redundant, since NFPA 70E is the standard for electrical safety in the workplace.

Article 220, Rotating Equipment, includes a new section on terminal boxes.

In the 2021 revision, Art. 300, Introduction (to Chapter 3) includes a section “Organization.” This is a quick overview of the Articles in Chapter 3. It’s redundant with the Table of Contents, and it’s been removed with the 2024 revision.

Document Changes

The informational Note in Art. 320 contained a list of 12 additional references. With the 2024 revision, that list is now 15.

You will find some changes in the Annexes, also. For example, Informative Annex C: Limits of Approach has a change to General Statement and a change to the final Section (regarding Column 4) – and it's now shorter than the 2021 revision

Document Changes

Article 330 (Safety-Related Work Practices: Lasers) has been extensively revised.

The scope of Art. 340 has been extended, with three more enumerated items added to the previous five.

The Several Articles have been extensively revised. The best example is arguably Art. 120, which addresses establishing an electrically safe work condition.

Section 110.2 Electrically Safe Work Condition (ESWC)

Testing for absence of voltage.

- Previously, NFPA 70E allowed the employer to define where it made sense to verify the circuit was de-energized but defined the process. The change states that now the absence of voltage test must take place at each point of work.
- Policy. **The employer shall establish, document, and implement an ESWC policy that does both of the following: (1) Requires hazard elimination to be the first priority, in the implementation of safety–related work practices. (2) Comply with section 110.2(B)**
- The intent is that no longer is it allowed for this test to be made at the disconnecting means upstream from the equipment being worked on, such as the device in the MCC where the LOTO equipment might be applied.
- **Electrically Safe Work Condition.** A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested **for** ~~to verify~~ the absence of voltage, and, if necessary, temporarily grounded for personnel protection.

NFPA 70E Changes

Section 110.2(B) Electrically Safe Work Condition (ESWC)

NEW

(B) When Required

Energized electrical conductors and circuit parts operating at voltages equal to or greater than 50 volts shall be put into an electrically safe work condition before an employee performs work if any of the following conditions exist.

(1) The employee is within the limited approach boundary.

(2) The employee interacts with equipment where conductors or circuit part are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists.

NFPA 70E Changes

Section 110.2(B) Electrically Safe Work Condition (ESWC)

Exception No. 1: Normal operation of electrical equipment shall be permitted where a normal operating condition exists. A normal operating condition exists when all of the following conditions are satisfied:

(1) The equipment is properly installed

(2) The equipment is properly maintained

(3) The equipment is rated for the available fault current (this is a new requirement)

(4) The equipment is used in accordance with instructions included in the listing and labeling and in accordance with the manufacturer's instructions.

(5) The equipment doors are closed and secured.

(6) All equipment covers are in place and secured.

(7) There is no evidence of impending failure

Following an outage involving maintenance of equipment, the equipment is NOT considered to be in normal operation.

Section 110.3 Emergency Response Plan Required

- The job safety planning process is now requiring that an emergency response plan be included in the planning process. The emergency response plan helps minimize confusion during rescue operations for employees involved in electrical incidents.
    - This could include how to respond to an injured worker.
    - Unexpected shutdown situation
    - Suddenly without power

Informational Note Table 130.7

New type of Protector for rubber insulating gloves

- A new standard, ASTM F3258, has been developed that gives guidance on how a protector can be built out of non-leather materials that meet certain performance criteria. The word “leather” was deleted from the phase protectors throughout NFPA 70E

NFPA 70E Changes

Section 320.1 Battery and Battery Rooms

- This Article covers electrical safety requirements for the practical safeguarding of employees while working with exposed stationary storage batteries that exceed 100 volts, nominal, or exceed a short circuit power of 1000 watts.
    - This was 50 volts in the previous standards

Section 320.3 Safety Procedures (A) General Safety Hazards

(1) Electrical Hazard Thresholds. Exposure levels shall not exceed those identified in the following list unless appropriate controls are implemented:

(1) AC: 50 volts and 5 milliamperes

(2) DC: 100 volts and 40 milliamperes

(3) Thermal: 1000 watts short-circuit power

Informational note No. 1: Available short-circuit power is calculated by multiplying the battery's nominal voltage by its available short-circuit current at the battery terminals then dividing by the result by two.

NFPA 70E Changes

Table 320.7(C)(15)(b) Arc Flash PPE Categories for dc Systems

Went from two tables to one table:

- Table 1 was Voltage range ≥ 100 V and ≤ 250 volts
- Table 2 was Voltage range ≥ 250 V and ≤ 600 volts

- New Table > 150 V and ≤ 600 volts

NFPA 70E Changes

Annex S

- This new Annex deals with the concept of assessing the condition of maintenance of electrical equipment during the risk assessment process.
- For several editions now, it has been a requirement that the condition of maintenance be considered when performing the risk assessment process. However, there wasn't solid guidance on "How To" do this from a risk assessment point of view.
- There is an inherent risk to workers associated with performing tasks on electrical equipment that is not properly rated, properly installed, has not been properly maintained or otherwise exhibits evidence of an increased risk level for electrical workers.
- If the equipment is not in good condition, the Arc Flash labels are no good.
- Keep in mind that an informative annex is not mandatory text.

OSHA/NFPA 70E Training requirements

- **Persons permitted to work within the limited approach boundary of exposed energized electrical conductors and circuit parts operating at 50 volts or more, shall at a minimum, be additionally trained in and demonstrate the abilities to:**
  - Distinguish exposed live parts from other parts of electrical equipment.
  - Determine nominal voltage of the exposed parts.
  - Be aware of minimum approach distances to exposed parts.
  - Determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

OSHA/NFPA 70E Training requirements

Training

- CPR, First Aid, and AED (automatic external defibrillator) training shall occur at a frequency that satisfies the requirements of the certifying body for employees responsible for responding to medical emergencies.
- Retraining required for tasks performed less frequently than annually.
- Specific training requirement for the use of test equipment for the verification of a zero-energy state.
- Training must be documented and is only considered complete after the employee has *demonstrated proficiency* in the work practices involved and shall include the content of the training.
- NFPA 70E requires refresher training every 3 years
  - Aligns with the new NFPA 70E edition published

OSHA/NFPA 70E Training requirements

Retraining is required when:

- Employees are found not complying with safety-related work practices during supervision or annual inspections*
- New technology, equipment, or changes in procedures
- If the worker must employ safety-related work practices that are not normally used during regular work duties

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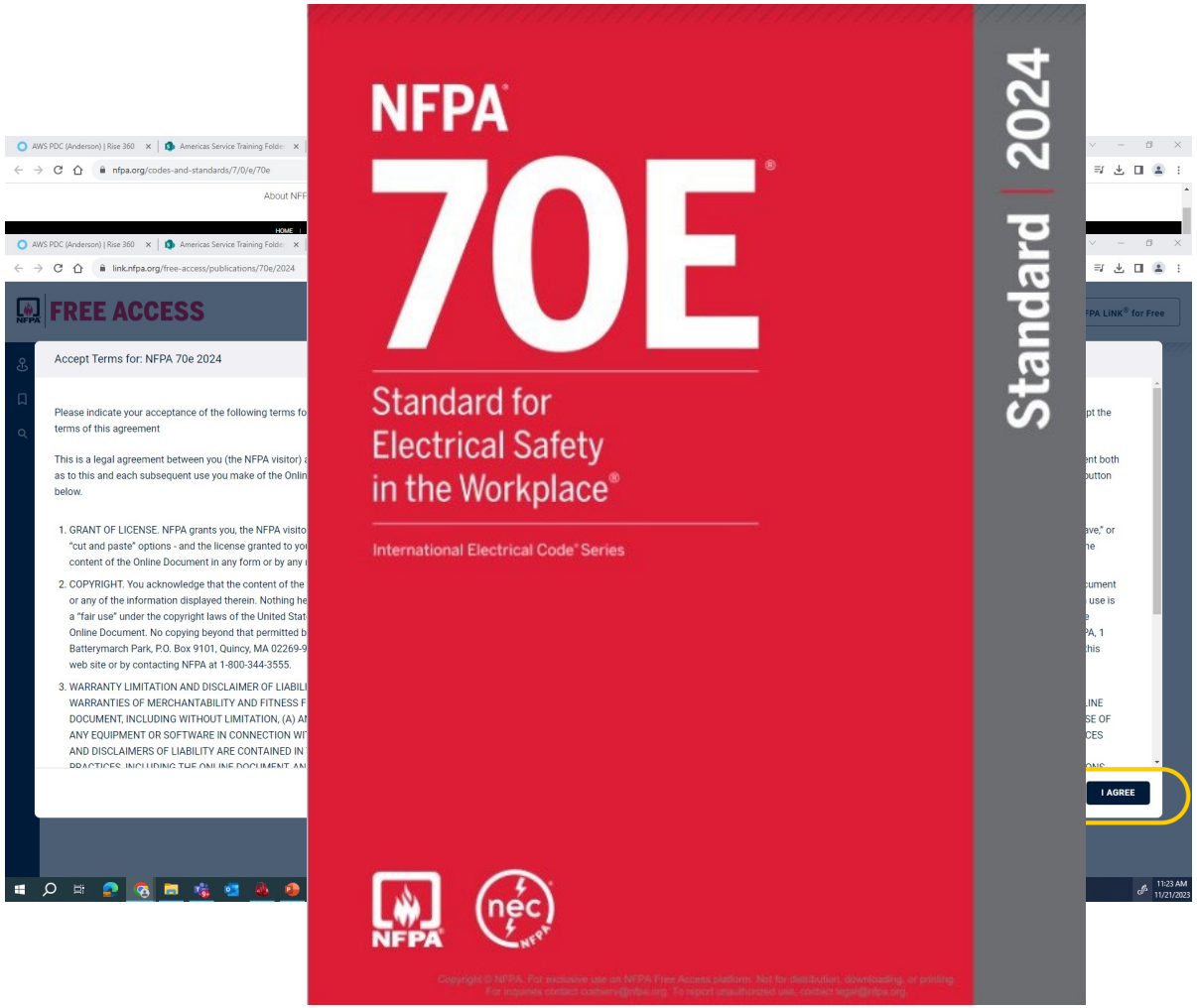

Section Review

Finish This Statement:

Persons permitted to work within the limited approach boundary of exposed energized electrical conductors and circuit parts operating at 50 volts or more, shall at a minimum, be additionally trained in and demonstrate the abilities to:

- Distinguish exposed live parts from other parts of electrical equipment.
- Determine nominal voltage of the exposed parts.
- Be aware of minimum approach distances to exposed parts.
- Determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

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Fundamentals of electrical hazards

Electrical hazards

What is an electrical hazard?

- A dangerous condition such that contact, or equipment failure can result in electric shock, arc flash burn, thermal burn, or arc blast injury.

Electric shock

- **What is an “electrical shock”?**
  - The physiological reaction, characterized by pain and muscular spasm, to the passage of an electric current through the body, which can affect the respiratory system and heart rhythm. It’s the result of a person coming into contact with and becoming part of an electric circuit. This circuit has four components:
    - Voltage
    - Frequency
    - Resistance
    - Current
- **Which of these is the fatal component of an electric shock?**

Skin resistance

- **Skin resistance depends on several factors, including:**
  - Moisture in the skin
  - Ambient temperature
  - Humidity
  - Fright
  - Anxiety
- **Skin resistance can vary from 500 ohms when moist to 300,000 ohms when dry.**
- **The average threshold that can be felt and withstood by the human body is 70VAC, based on dry skin and will vary due to skin resistance.**

Current magnitudes

- **There are several serious consequences associated with current flow through the body, including:**
  - Involuntary movement or reflex action
  - Physical damage to the body and point of entrance and exit
  - Damage or cessation of vital organs
  - Muscular contractions that result in asphyxiation or cause a person to grip an energized conductor and not let go.
  - Internal damage due to heat generated by current flow.
  - Disruption of nervous system.
  - Fibrillation of the heart muscle.

Human response to electric shock

- **Immediate**
  - Confusion, amnesia, headache, breathing stops, heart stops, burns.
- **Secondary**
  - Paralysis, muscular pain, vision abnormalities, swelling, headache, and cardiac irregularities.
- **Long Range**
  - Paralysis, speech/writing disorders, loss of taste, loss of mental acuity, and PTSD as a result of nerve tissue damage.

Electric shock

- **What are some of the main types of electrical shock injuries?**
  - Electrocution
  - Electrical Shock
  - Burns
  - Falls

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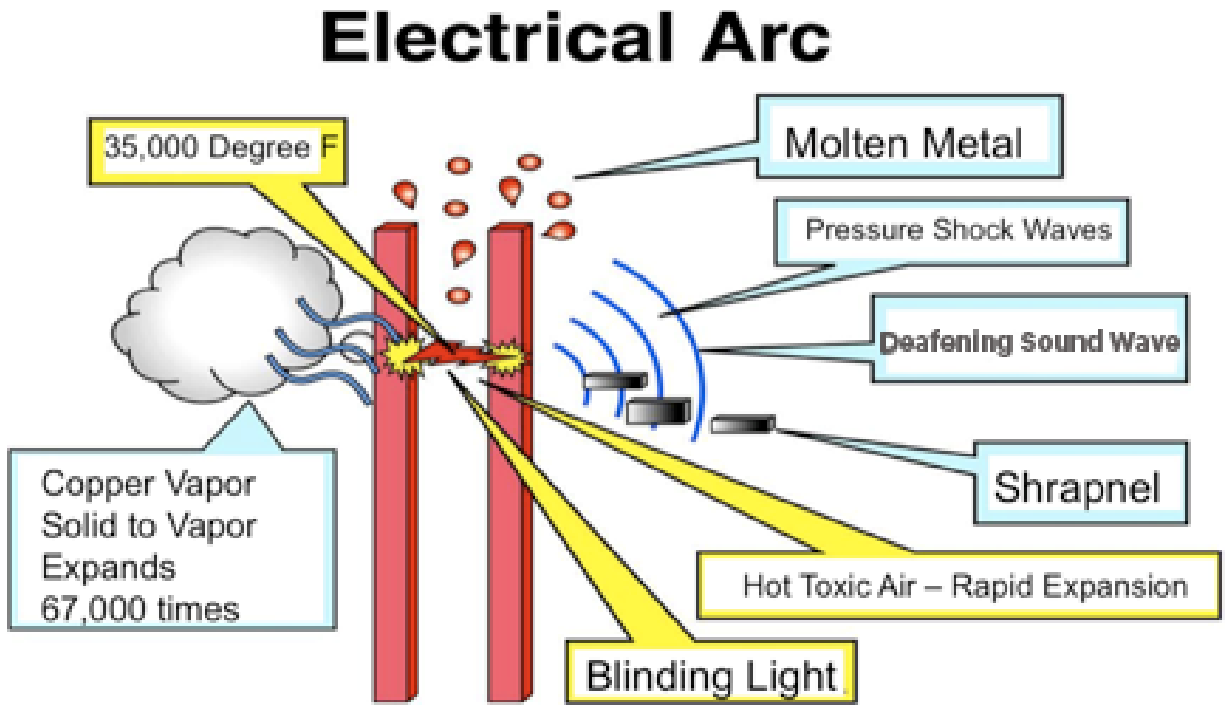
Arc Flash

Arc Flash

- What is an “arc flash”?
  - A phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground. The results are often violent and when a human is in close proximity to the arc flash, serious injury and even death can occur.



Lets take a look at the anatomy of a fault condition…

Quantifying the Arc Flash

- The damage due to an arc blast is often a function of the “system duty”, or the amount of power that will flow through a short circuit in a power system.
  - Often expressed in MVA or short-circuit current.
  - The energy released during a fault will then be a function of fault duration and system duty.
- By knowing the arcing current, system voltage, and duration of the fault, the Arc Energy (cal/cm^2) can be calculated.
  - One calorie is that amount of energy that will raise the temperature of one cubic centimeter of water one degree Centigrade.
  - Direct skin exposure to heat energy at 1.2 cal/cm^2 will result in the onset of a second-degree burn.

Burns

Healthy Human Tissue	98.6°F
Copper Melts	1,985°F
Surface of the Sun	9,000°F
Electric Arc	**15,000 - 35,000°F**
Laser and Thermonuclear Reaction	100,000°F
Inside the Sun	10,000,000°F

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Establishing an Electrically Safe Work Condition

Definition

What is an "Electrically Safe Work Condition"?

- A state in which an electrical conductor or circuit part has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to verify the absence of voltage and, if necessary, temporarily grounded for personnel protection.

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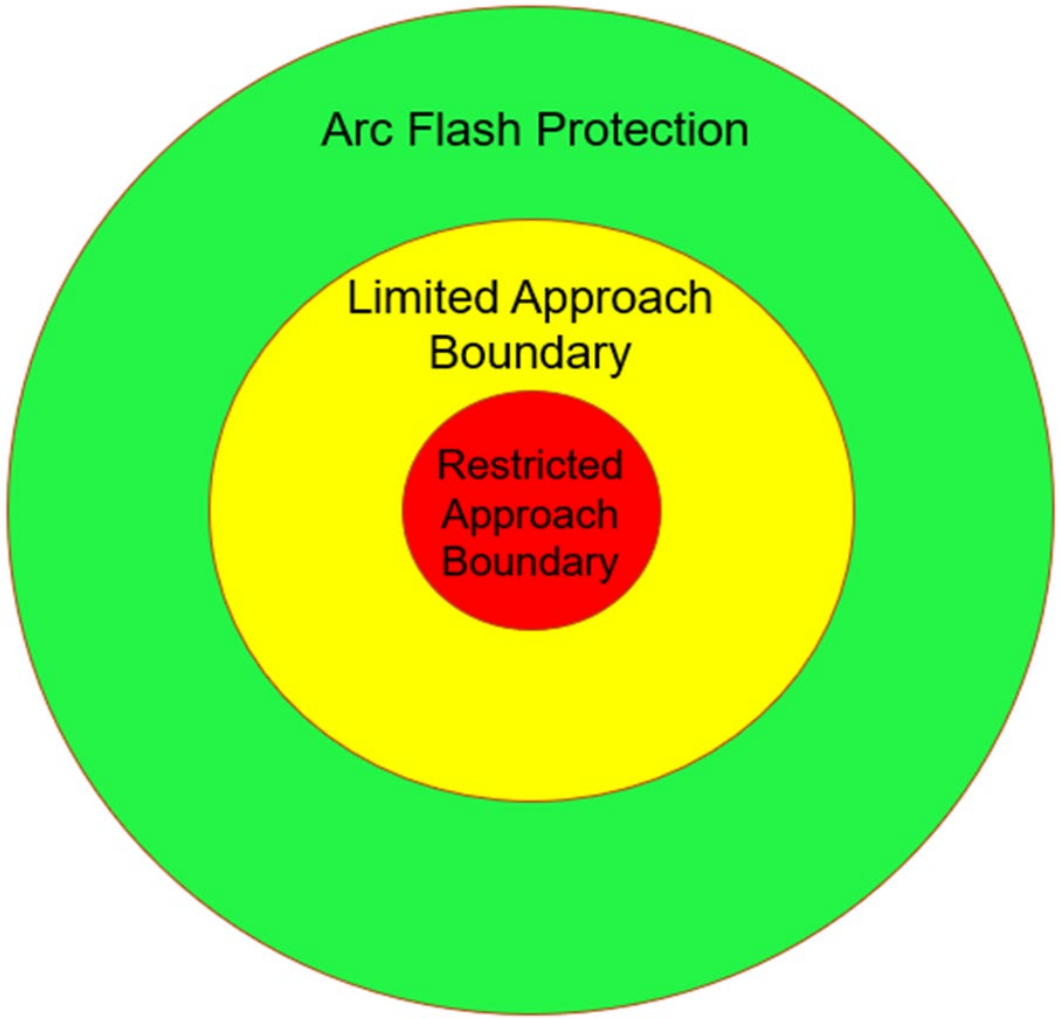
Understanding Approach Boundaries

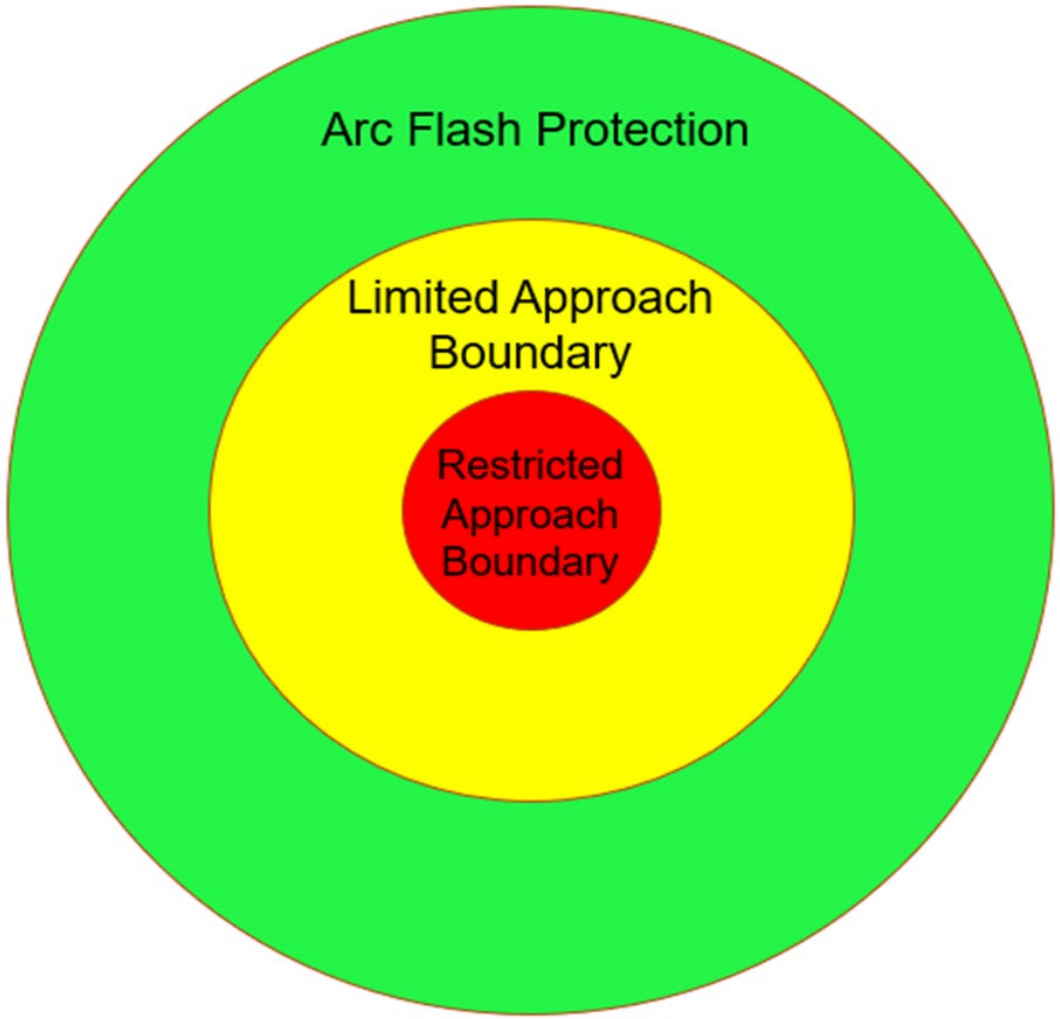
Approach Boundaries

- **Arc Flash Boundary:**
  - An approach limit at a distance from exposed live parts within which a person could receive a second-degree burn if an electrical arc flash were to occur.
  - Only “Qualified” persons are permitted to cross this boundary
  - The boundary of this zone is the point at which the calculated energy falls below 1.2 cal/cm^2, which is the onset of a second-degree burn.



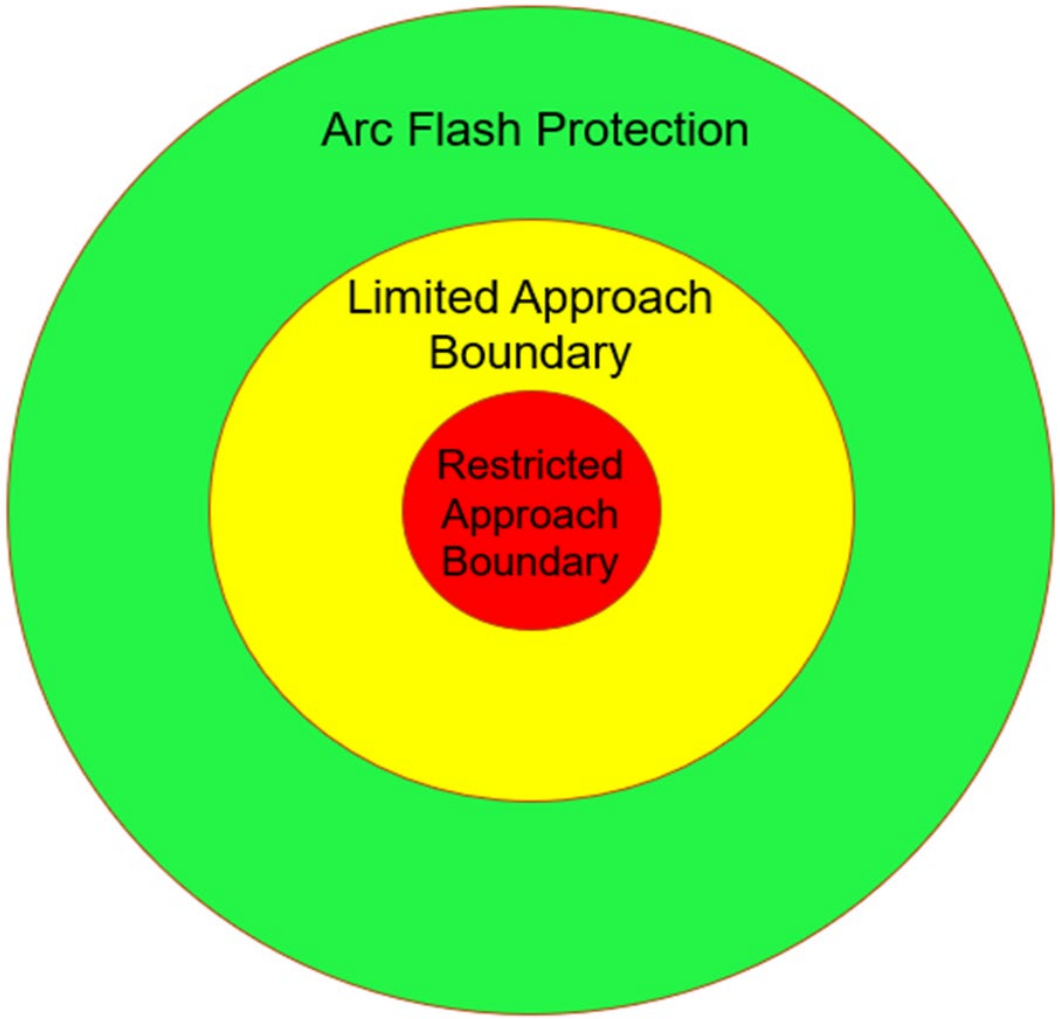
Approach Boundaries

- **Limited Approach Boundary:**
  - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.
  - This is where the boundary is established to keep unqualified persons away from the area
  - Appropriate PPE must be used beyond this point
  - Only “Qualified” persons are permitted to cross this boundary
    - Where there is a need for an unqualified person(s) to cross the limited approach boundary, a qualified person shall advise the unqualified person(s) of the possible hazards and continuously escort the unqualified person(s) while inside the limited approach boundary. Under no circumstance shall the unqualified person(s) be permitted to cross the restricted approach boundary.



Approach Boundaries

- **Restricted Approach Boundary:**
  - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased risk of shock, due to electrical arc-over combined with inadvertent movement, for personnel working in close proximity to the energized electrical conductor or circuit part.
  - This shock protection boundary is the approach limit for qualified employees.
  - If a qualified employee crosses the restricted approach boundary, they must be protected from unexpected contact with the conductors or circuit parts that are energized and exposed.



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Responding to an Electrical Incident

Rescuing a Shock Victim

- Determine if they are on a live circuit – always assume circuit is energized!
- Never attempt to remove the person from a live circuit with your bare hands – you risk compounding the problem!
- Actions:
  - De-energize the circuit, if possible
  - Call for help
  - Use insulated device to pull the worker free from circuit
  - Apply CPR, if necessary
  - Obtain medical assistance