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OSHA/NFPA 70E SAFETY-RELATED

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Purpose

- Acquire and demonstrate technical knowledge and skills to successfully perform Electrical Safe Work Practices during routine electrical work, equipment inspections and safety compliance reviews; and
- Meet the basic requirements for **Qualified Persons** as defined by OSHA and NFPA 70E.

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Regulatory and Consensus Standards

OSHA

- 29 CFR Part 1910 Subpart "S" → General Industry
- 29 CFR Part 1926 Subpart "K" → Construction
- 29 CFR Part 1926 Subpart "V" → Power Transmission and Distribution
- NFPA #70E – 2024 → Standard for Electrical Safety in the Workplace
- NFPA #70 – 2023 → National Electric Code

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Hazards of Electricity

a) Shock

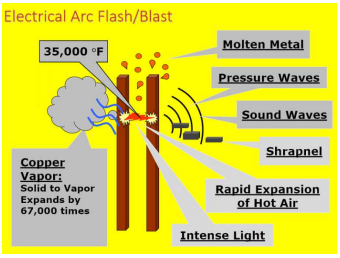
b) Burns

c) Blast

d) Fire

e) Falls

f) Light



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Shock

- 2,380 non-fatal accidents in 2020 (reported)
- 126 electrical fatalities in the year 2020
  - 64% → Construction & Maintenance Related
  - 13% → Building and Grounds Maintenance
- Typically, in top 5 of industrial fatalities every year
- ALWAYS seek medical attention → Death up to 24 hours after exposure
- 0.001 Amps = 1 mA = Threshold for shock

WHY?

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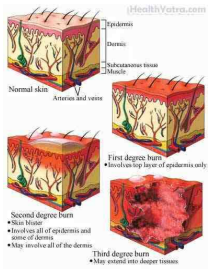
Burns

- Electrical (Entry/Exit Wounds)
- Arc Flash (Radiant Heat)
- Secondary Impacts
  (super heated gases, molten materials, clothing ignition)



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Arc Flash

Cause – Conductor's insulation (or isolation) is breached or is unable to withstand the applied voltage leading to a phase-to-phase or phase-to-ground fault resulting in a release of an enormous amount of radiant energy.

Translation: An Electrical Explosion

Ex./ 10,000 A arc at 480v = Stick of TNT

Initial event often followed by secondary (or more) events as damaged equipment results in additional faults.

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Arc Blast

- Rapid heating results in overpressure (think lightning strike)
- Shrapnel results at > 700 mph
- Sound pressures > 160 dB
  (Jet Engine = 150 dB)
- Pressures can exceed 2,000 psf
  - Rupture eardrums (720 psf)
  - Collapse lungs (1,728 – 2,160 psf)

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Controlling Hazards: Lung Boundary

Annex "R" Working with Capacitors

Blast Hazard

- Hearing protection should be used above 100 Joules
- Lung Boundary – Above 122 kJoules

THERE IS NO PROTECION!

Do Not Enter the Lung Protection Boundary

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Other Hazards

- **FIRE** – Radiant heat exceeds surrounding material ignition energy
- **FALLS** – Results from overpressure or muscle contraction
- **LIGHT** – Can result in eye damage and development of cataracts

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Meter Selection

Ask yourself……

- What data am I trying to obtain…Volts, Amps, etc.
  - Will my meter provide what I'm looking for?
- What is the maximum value I am measuring…
  - Is my equipment appropriately rated?
- Where am I using the meter?
  - Category IV, III, II or I

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Meter Standards

- Denotes 4 categories of overvoltage protection
  - → Cat IV – Origin of installation such as utility level or outside cable run
  - → Cat III – Distribution wiring mains, feeders, branch circuits, permanently installed loads
  - → Cat II – Receptacle outlet circuit, plug-in loads
  - → Cat I – Protected circuits

Within each category are designated working voltages such as 600v or 1,000v with a transient rating

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Testing Basic Procedures

"Absence of Voltage" Testing

**** At the point of work !***

Step 1 – Position probes

(black lead is first on and last off)

Step 2 – Verify meter or known energized source before and after target test

Step 3 – Verify circuit is off

(disconnect is in open position)

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Checking for Induced Voltage

- Residual voltage may be the result of back feed or equipment failure.

Do not assume that it is a ghost voltage !

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Controlling Hazards: Training

- Any employee at risk from electrical hazard not reduced to safe levels via installation requirements, requires training.

  Performed a minimum of every 3 years (NFPA 70E)

- Can be classroom or on-the-job, or a combination of both
- Level or degree based on employee risk

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Controlling Hazards: Performing Risk Assessments NFPA #70E – 2024 (Annex "F")

Risk Control Method	Examples
(1) Elimination	Conductors and circuit parts in an electrically safe working conditions
(2) Substitution	Reduce energy by replacing 120 V control circuitry with 24 Vac or Vdc control circuitry
(3) Engineering controls	Guard energized electrical conductors and circuit parts to reduce the likelihood of electrical contact or arcing faults
(4) Awareness	Signs alerting of the potential presence of hazards
(5) Administrative controls	Procedures and job planning tools
(6) PPE	Shock and arc flash PPE

Figure F.3

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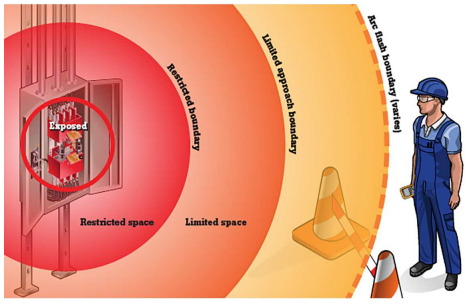
Controlling Hazards: Shock Protection Approach Boundaries – Annex "C"



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Controlling Hazards: Shock Protection

Table 130.4(E)(a)

Electric Shock Protection Approach Boundaries to Exposed Energized Electrical Conductors or Circuit Parts for Alternating-Current Systems

(1)	(2)	(3)	(4)
Nominal System Voltage Range, Phase to Phase[a]	Limited Approach Boundary[b]		Restricted Approach Boundary[b,d] Includes Inadvertent Movement Adder
	Exposed Movable Conductor[c]	Exposed Fixed Circuit Part	
Less than 50 V	Not specified	Not specified	Not specified
50 V-150 V[e]	3.1 m (10 ft. 0 in.)	1.0 m (3 ft. 6 in.)	Avoid contact
151 V-750 V	3.1 m (10 ft. 0 in.)	1.0 m (3 ft. 6 in.)	0.31 m (1 ft. 0 in.)
751 V-5 kV	3.1 m (10 ft. 0 in.)	1.0 m (3 ft. 6 in.)	0.63 m (2 ft. 1 in.)
5.1 kV-15 kV	3.1 m (10 ft. 0 in.)	1.5 m (5 ft. 0 in.)	0.65 m (2 ft. 2 in.)
15.1 kV-36 kV	3.1 m (10 ft. 0 in.)	1.8 m (6 ft. 0 in.)	0.77 m (2 ft. 7 in.)
36.1 kV-46 kV	3.1 m (10 ft. 0 in.)	2.5 m (8 ft. 0 in.)	0.84 m (2 ft. 10 in.)

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Controlling Hazards: Arc Flash Protection

- General: NFPA #70E require analysis
  - Boundary determination based on
    - Incident Energy of 1.2 cal/cm^2 at 18 inches from part
  - Calculate based on Annex "D"
  - Incident Energy Method
    - PPE based on Energy 1.2 – ? cal/cm^2
  - Category Method
    - PPE based on Hazard/Risk Category 1 – 4

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Controlling Hazards: Arc Flash – Assessing PPE Requirements

Table 130.7(C)(15)(a)
Arc Flash PPE Categories for Alternating Current (ac) Systems
(- Abbreviated -)

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 volts or below Parameters: Maximum of 25 kA available fault current; Maximum of 0.03 sec (2 cycles) fault clearing time; Minimum working distance 455 mm (18 in.)	1	485 mm (19 in.)
Panelboards or other equipment rated greater than 240 volts and up to 600 volts Parameters: Maximum of 25 kA available fault current; Maximum of 0.03 sec (2 cycles) fault clearing time; Minimum working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-volt class motor control centers (MCCs) Parameters: Maximum of 42 kA available fault current; Maximum or 0.33 sec (20 cycles0 fault clearing time; Minimum working distance 455 mm (18 in.)	4	4.3 m (14 ft)
600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards Parameters: Maximum of 35 kA available fault current; Maximum of up to 0.5 sec (30 cycles) fault clearing time; Minimum working distance 455 mm (18 in.)	4	6 m (20 ft)
Other 600-volt class (277 volts through 600 volts, nominal) equipment		

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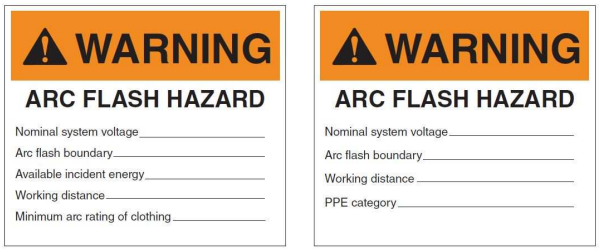
Alerting Techniques



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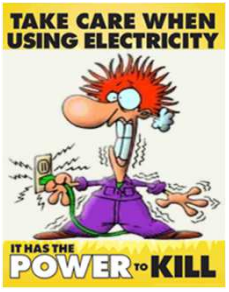
Questions



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