ELECTRICAL SAFETY

Beyond GFCI's and Extension Cords

INTRO

- PAT DAUGHERTY
  - pdaugherty@electricplus.com
  - 317-718-0100
- CONSTRUCTION ELECTRICIAN FOR 32 YEARS
- ELECTRICAL SAFETY
  - Beyond GFCI's and extension cords

STATISTICS

Table 2

Nonfatal Electrical Injuries Involving Days Away from Work, by Event, Private Industry, 1992 - 2020

Year	Total
1992	4,806
1993	4,995
1994	6,018
1995	4,744
1996	4,126
1997	3,710
1998	3,910
1999	4,224
2000	3,704
2001	3,394
2002	2,967
2003	2,390
2004	2,650
2005	2,950
2006	2,620
2007	2,540
2008	2,490
2009	2,620
2010	1,890
2011	2,250
2012	1,700
2013	2,090
2014	1,850
2015	2,480
2016	1,640
2017	2,210
2018	1,560
2019	1,900
2020	2,220
Total	**86,648**

Compiled by the Electrical Safety Foundation International using data from the U.S. Bureau of Labor Statistics, CFOI, 1992-2020

Table 1

Fatalities by Event, all ownerships, 2003 - 2020																				
Rank	Event or Exposure	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Fatalities
1	Transportation, excluding water, rail, air	2,041	2,118	2,173	2,081	2,057	1,829	1,516	1,600	1,670	1,695	1,628	1,737	1,821	1,855	1,835	1,841	1,860	1,592	**31,357**
2	Assaults and Violent Acts	902	809	792	788	864	816	837	832	791	803	773	765	703	866	807	828	841	705	**13,817**
3	Falls, slips, trips	696	822	770	827	847	700	645	646	681	704	724	818	800	849	887	791	880	805	**13,087**
4	Struck by object or equipment	531	602	607	589	504	520	420	404	476	519	509	503	519	553	503	566	518	468	**8,843**
5	Exposure to harmful substances or environments, excluding electrical	240	210	250	297	285	247	234	250	245	184	194	236	290	364	395	461	467	546	**4,849**
6	Caught in or compressed by equipment or objects	238	269	278	283	296	302	233	228	145	174	131	137	99	117	108	137	120	142	**3,240**
7	Contact with / Exposure to electric current	246	254	251	250	212	192	170	164	174	156	141	154	134	154	136	160	166	126	**3,114**
8	Aircraft	211	231	149	217	174	191	159	152	145	127	136	135	139	130	126	133	152	80	**2,707**
9	Struck, caught, or crushed in collapsing structure, equipment, or material	126	117	109	108	108	100	80	91	84	73	78	74	90	82	70	73	83	93	**1,546**
10	Explosions	75	75	65	99	75	80	60	80	82	88	67	84	75	55	85	71	57	40	**1,273**
11	Water Vehicle	69	91	88	96	71	76	86	60	72	63	60	55	44	48	68	58	63	74	**1,168**
12	Railway	43	50	83	65	49	34	34	45	50	38	41	57	50	50	48	48	47	32	**832**
	Other	157	116	119	140	115	127	77	138	78	54	103	71	72	67	79	83	79	61	**1,675**
	Total Fatalities (all causes)	**5,575**	**5,764**	**5,734**	**5,840**	**5,657**	**5,214**	**4,551**	**4,690**	**4,693**	**4,628**	**4,585**	**4,821**	**4,836**	**5,190**	**5,147**	**5,250**	**5,333**	**4,764**	**87,508**

Compiled by the Electrical Safety Foundation International using data from the U.S. Bureau of Labor Statistics, CFOI, 2003-2020

THE HAZARDS

- Electrical Shock / Electrocution
- Arc Flash / Arc Blast

REGULATORY

- **OSHA**
  - Ensure safe and healthful working conditions for workers by **setting and enforcing standards and by providing training, outreach, education, and assistance.**
- **NFPA 70** – National Electrical Code
  - **Practical safeguarding of persons and property from hazards arising from the use of electricity.**
- **NFPA 70E**
  - Addresses electrical safety-related work practices, safety-related maintenance requirements, and other administrative controls for employee workplaces that are necessary for **the practical safeguarding of employees relative to the hazards associated with electrical energy during activities** such as the installation, removal, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways.

OSHA DOES NOT ENFORCE NFPA

OSHA 1910
GENERAL INDUSTY

OSHA 1910 Subpart S - Electrical

- 1910.333(a)
  - "General." Safety-related work practices shall be employed **to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts**, when work is performed near or on equipment or circuits which are or may be energized.

OSHA 1910 Subpart S - Electrical

- 1910.333(a)(1)
  - "Deenergized parts." **Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations**. Live parts that operate at less than 50 volts to ground need not be deenergized if there will be no increased exposure to electrical burns or to explosion due to electric arcs.
    - *Note 1: Interruption of life support equipment, deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment, or removal of illumination for an area.*
    - *Note 2: Infeasibility – Testing or integral part of continuous process of industrial chemical plant.*

OSHA 1910 Subpart S - Electrical

- 1910.333(a)(2)
  - "Energized parts." **If the exposed live parts are not deenergized** (i.e., for reasons of increased or additional hazards or infeasibility), **other safety-related work practices shall be used** to protect employees who may be exposed to the electrical hazards involved.

OSHA 1910 Subpart S - Electrical

- 1910.333(b)(1)
  - Deenergized parts must be considered energized if they are not locked out or tagged out.

OSHA 1910 Subpart S - Electrical

- 1910.333(b)(2)
  - "Lockout and Tagging." While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been deenergized, **the circuits energizing the parts shall be locked out or tagged or both.**

OSHA 1926 CONSTRUCTION

OSHA 1926 Subpart B – General Interpretations

- 1926.16
  - Prime contractor assumes responsibility to adhere to the standards of all work under contract.
  - Subcontractor assumes responsibility to adhere to the standards of all work under their portion of a contract

OSHA 1926 Subpart K - Electrical

- 1926.416(a)
  - Protection of employees
- 1926.416(a)(1)
  - **No employer shall permit an employee to work in such proximity** to any part of an electric power circuit that the employee could contact the electric power circuit in the course of work, **unless the employee is protected against electric shock by deenergizing the circuit and grounding it or by guarding it effectively by insulation or other means**.

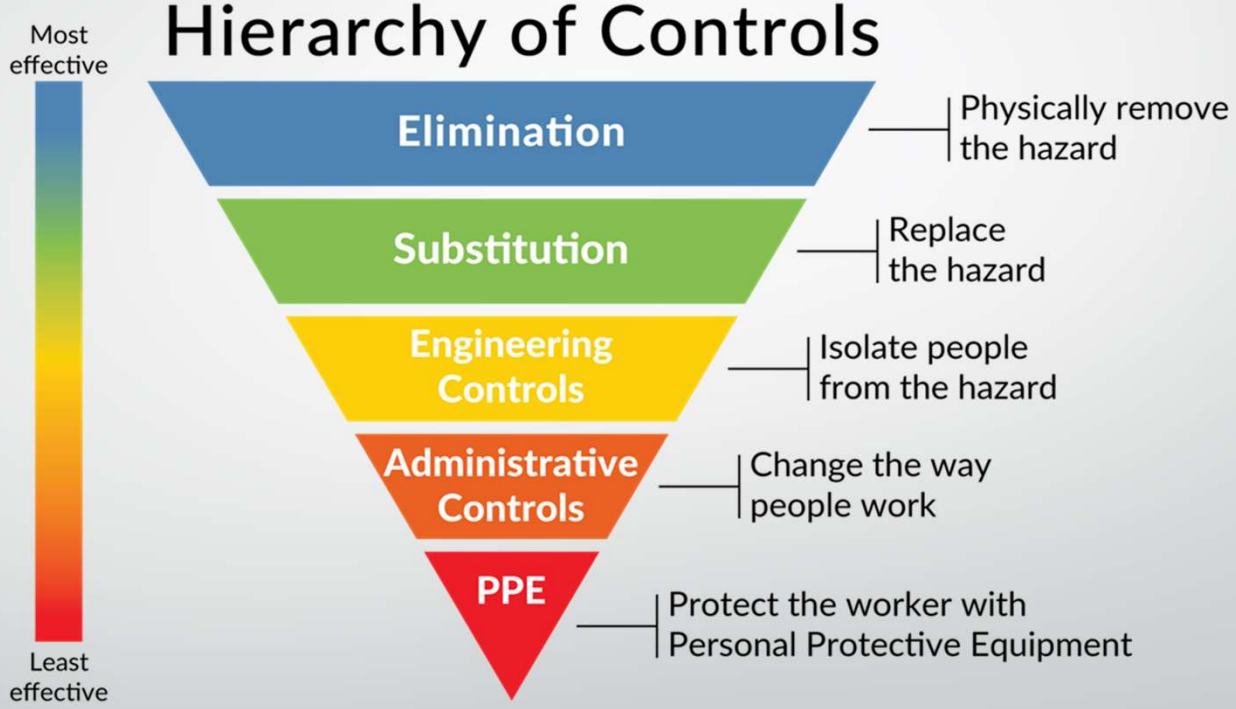
NFPA 70E


WARNING
Arc Flash &
Shock Hazard
Follow requirements in
NFPA 70E for safe work
practices and appropriate
personal protective

NFPA 70E SAFE WORK CONDITION

- 110.1 Priority.
  - Hazard elimination shall be the first priority in the implementation of safety-related work practices.
  - *Informational Note No. 1: Elimination is the risk control method listed first in the hierarchy of risk control identified in **110.5(H)***

Hierarchy of Controls



NFPA 70E SAFE WORK CONDITION

- 110.2 General.
  - Electrical conductors and circuit parts shall not be considered to be in an electrically safe work condition until all of the requirements of Article 120 have been met.

Article 120 Establishing an Electrically Safety Work Condition – LOTO

NFPA 70E SAFE WORK CONDITION

- 110.3 Electrically Safe Work Condition
  - 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** (3’-10’).
  - (2) The employee **interacts with equipment** where conductors or **circuit parts are not exposed but an increased likelihood of injury from an exposure to an arc flash hazard exists**

NFPA 70E ENERGIZED WORK

- 110.4 Energized Work.
  - (A) Additional Hazards or Increased Risk.
    - Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk.
      - Interruption of life-support equipment
      - Deactivation of emergency alarm systems (FA, Code Blue, Nurse Call, etc.)
      - Shutdown of hazardous location ventilation equipment

NFPA 70E ENERGIZED WORK

- 110.4 Energized Work.
  - (B) Infeasibility.
    - Energized work shall be permitted where the employer can demonstrate that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations.
      - Performing diagnostics and testing
      - Troubleshooting
      - Observations

NFPA 70E ENERGIZED WORK

- 110.4 Energized Work.
  - (C) Equipment Operating at Less Than 50 Volts.

TABLES NFPA 70E ENERGIZED WORK

- 110.4 Energized Work.
  - (D) Normal Operating Condition.
    - The equipment is properly installed.
    - The equipment is properly maintained.
    - The equipment is used in accordance with manufacturer's instructions.
    - The equipment doors are closed and secured.
    - All equipment covers are in place and secured.
    - There is no evidence of impending failure

ENERGIZED WORK PERMIT

- Must be signed by customer representative with electrical knowledge.
- Customer declares that equipment cannot be deenergized because it creates a higher risk to deenergize.

NFPA 70E Host and Contract Employers'

- 110.7 Host and Contract Employers' Responsibilities.
  - (A) Host Employer Responsibilities.
    - Shall notify contract employer of hazards
    - Shall notify contract employer of their electrical safety program
    - Responsible to verify contract employer is following electric safety program

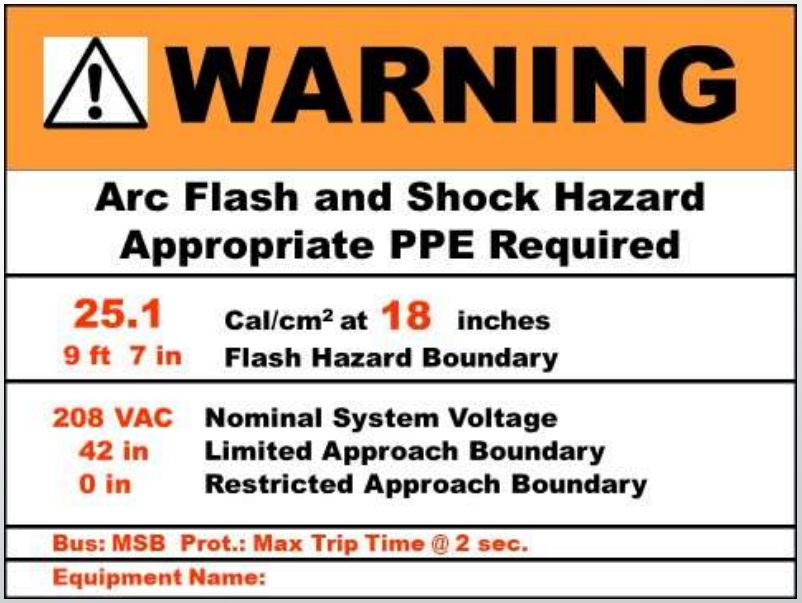
NFPA 70E

ADDITIONAL HOST EMPLOYER RESPONSIBILITIES

130.5 Arc Flash Risk Assessment

(H) Equipment Labeling.

- Electrical equipment shall be marked with a label containing all the following information:



The data shall be reviewed for accuracy not to exceed 5 years.

The owner of the electrical equipment responsible for the installation and maintenance of label.

ADDITIONAL HOST EMPLOYER RESPONSIBILITIES

NFPA 70E

- 205.2 Single-Line Diagram.
  - Maintained and legible condition
  - Kept current
- 205.12 Identification of Circuits.
  - Panel schedule securely affixed
  - Maintained in update and legible condition

NFPA 70E Host and Contract Employers'

- 110.7 Host and Contract Employers' Responsibilities.
  - (B) Contract Employer Responsibilities.
    - Shall ensure its employees are following electrical safety program
    - Notify host employer of any additional hazards recognized during work

THE DILEMMA

THE CUSTOMER REQUESTS A NEW CIRCUIT TO BE INSTALLED FOR A PIECE OF EQUIPMENT.

THE EQUIPMENT SHUT DOWN REQUEST

WE ARE UNSURE OF WHAT THAT PANEL FEEDS

- One-line drawings?
- Panel schedules?

WE'VE NEVER HAD TO SHUT OFF POWER DO THIS TYPE OF WORK BEFORE

- Is the facility maintenance crew not familiar with or not following their employer electrical safety program?
- Are other outside contractors not following their own or the customers electrical safety program?
- What about the OSHA standards?

WE CAN'T SHUT DOWN PRODUCTION

- Scheduled Outage vs. Unscheduled Outage?
- What is it worth?

IF WE HAVE TO SHUT IT DOWN, OUR EMPLOYEES MIGHT AS WELL DO IT.

- Are the contractors' employees more expendable than the customers employees?

I GUESS WE WILL JUST HIRE *(INSERT COMPETITOR HERE)* TO DO THE WORK

- If they are willing to do this work, how qualified are their employees to work in the customers facility?
- Is the customer willing to take on this liability?
- **Go ahead, your facility is not worth our employee being injured or killed!**

IT’S ONLY 120 VOLTS

- Path of the current through the body
- The amount of current flowing through the body
- The amount of time the body is exposed to the current
- Arc flash/arc blast events can be worse

IT’S ONLY 120 VOLTS

120 volt

480 volt

DON’T YOU HAVE ARC FLASH PPE?

- NFPA 70E is written for survivability
- Testing of arc flash equipment
- Arc blast

ARC FLASH/ARC BLAST

THE ARC IN A BOX

CONCLUSION

- Become familiar with NFPA 70E and OSHA's safe electrical work practices
- Train all employees to be familiar with your electrical safety program
- Seek ways to elimination or control electrical hazards
- Thank you for your time!