

There's always a solution in steel.

AISC Safety Committee Presents:

“Electrical Safety in the Workplace”



Speaker: Scott Mitchell



AISC Live Webinars

Today's audio will be broadcast through the internet.

Alternatively, to hear the audio through the phone,
dial 800 754 1346.

International callers, dial 00 +1 212 231 2933.

*For additional support, please press *0 and you will be
connected to a live operator.*



AISC Safety



AISC Live Webinars

Today's live webinar will begin shortly.

Please standby.

As a reminder, all lines have been muted. Please type any questions or comments through the Chat feature on the left portion of your screen.

Today's audio will be broadcast through the internet.
Alternatively, to hear the audio through the phone, dial
800 754 1346.

International callers, dial **00+1 212 231 2933.**

*For additional support, please press *0 and you will be connected to a live operator.*



AISC Safety

AISC Safety

- AISC Safety Committee is kicking off a new safety webinar series
- This first safety webinar is made free to all members and non-members
- The second safety webinar is in the process of being developed. The topic is OSHA's Hazard Communication on Globally Harmonized System (GHS).



AISC Safety

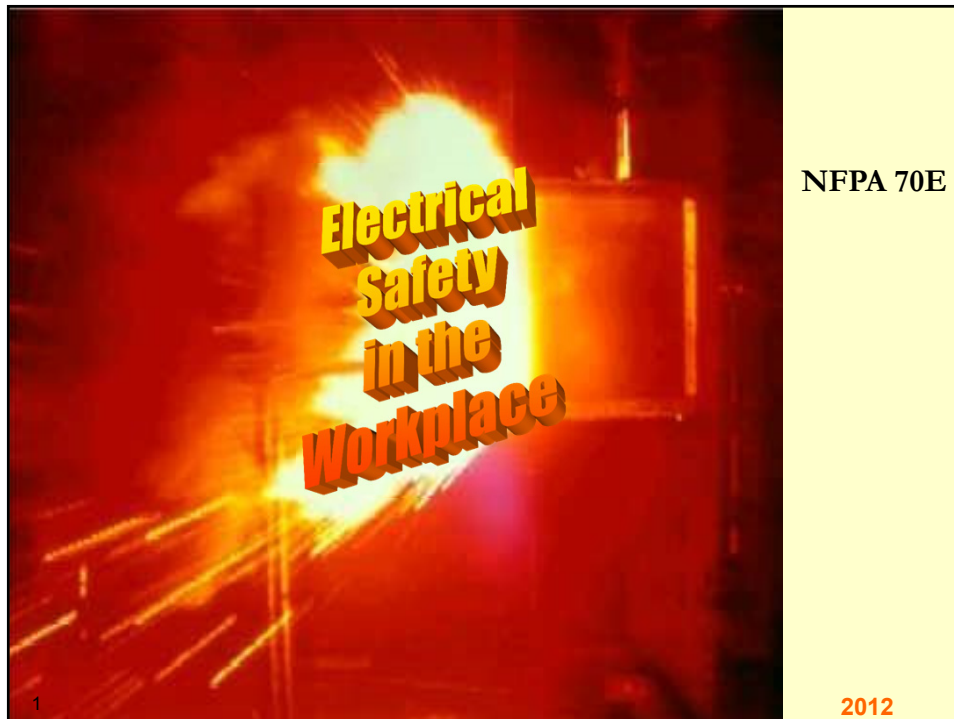
Scott Mitchell



- Cianbro Corp.
- 30 years of electrical related experience
- Master Trainer
- OSHA instructor
- American Heart instructor



AISC Safety



OBJECTIVES:

- Increase awareness of electrical hazards in the workplace
- Understand requirements of NFPA 70E in relation to OSHA
- Improve ability to determine safe work practices



"This presentation is based upon information derived from NFPA and OSHA publications. Questions and requests for interpretations of this information or these publications should be directed to NFPA and OSHA. AISC does not endorse any interpretation of these publications other than those interpretations formally issued by NFPA or OSHA."

7

Introduction

- NFPA 70E offers electrical safety standard practices to protect workers from Shock, Flash, and Blast related to electrical energy.
- OSHA recognizes NFPA 70E as a resource for compliance with their regulations.
- Equipment must be labeled with information to identify the associated hazards.
- Electrical work must be performed in a de-energized state unless permitted by Section 130.2(A).
- A hazard analysis, job briefing, and energized work permit are all required to perform energized work.
- Only qualified workers may perform electrical work while exposed to the hazards.
- Qualified workers must follow established procedures and wear appropriate PPE while performing energized work.

8

NFPA 70E

- NFPA 70E was developed in response to a request by OSHA to help define safe work practices regarding electrical energy in the workplace.
- Although OSHA does not mandate compliance with NFPA 70E, it considers the standard an effective guideline for following their regulations.

9

OSHA

- Section 5(a)(1): General Duty Clause – The employer must furnish a job and a workplace which are free from recognized hazards that are likely to cause death or serious physical harm.
- Compliance with 70E serves as a guide to compliance with both OSHA Standards- *1910 Subpart S* for General industry applications, and *1926 Subpart K* for Construction.

10



Informative Annex K

There are three general categories of electrical hazards:

- **Electrical Shock**
- **Arc Flash**
- **Arc Blast**

11

Electric Shock

- Approximately 30,000 nonfatal electrical shock accidents occur each year.
- The National Safety Council estimates that about 1000 fatalities each year are due to electrocution.
- Electrocution is the fourth leading cause of industrial fatalities
- The current required to light a 7 1/2-watt, 120-volt lamp, if passed across the chest, is enough to cause a fatality.

12



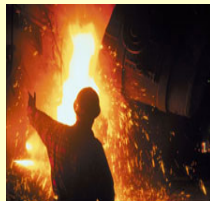
Arc Flash

- When an electric current passes through air either phase to phase or phase to ground, the temperatures can reach 35,000 degrees Fahrenheit.
- Exposure to these temperatures both burns the skin directly and causes ignition of clothing.
- **ARC FLASHES CAN AND DO KILL AT DISTANCES OF 10 FEET !**

13

Arc Blast

- The tremendous temperatures of the arc cause the explosive expansion of both the surrounding air and the metal in the arc path.
- The danger associated with this expansion is one of high pressures, sound, and shrapnel.
- When changing from a solid to a vapor, copper expands by a factor of 67,000 times.
- The high pressures can exceed thousands of pounds per square foot.
- The sounds associated with these pressures can exceed 160 dB.
- Material and molten metal can be expelled away from the arc at speeds exceeding 700 mph, fast enough for shrapnel to completely penetrate the human body.



14

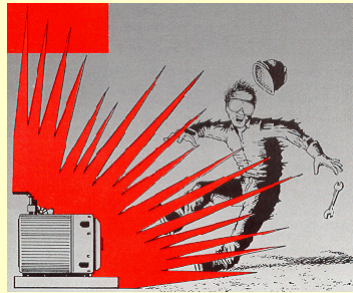
EXPOSED

Capable of being inadvertently touched, or approached nearer than a safe distance by a person.

This term is applied to electrical conductors or circuit parts that are not suitably guarded, isolated, or insulated.




PPE REQUIRED!




15

Equipment Labeling

Switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons.

| | |
|--|---------------------------|
|  WARNING | |
| Arc Flash Hazard Appropriate PPE Required | |
| Equipment Type | 600V Switchgear |
| Grounding | Grounded |
| Work Distance | 23 inches (600 mm) |
| Available 3-Ph Bolted Current | 45 kA |
| Flash Protection Boundary | 200 inches |
| Incident Energy at 23 inches | 28.95 cal/cm ² |
| PPE Level | 4 |
| Label created and printed from www.arcadvisor.com | |

| | |
|--|------------------------------------|
| 480 VOLTS | |
|  DANGER | |
| Arc Flash and Shock Hazard NO SAFE PPE EXISTS | |
| ENERGIZED WORK PROHIBITED | |
| 480 VAC | Shock Hazard when cover is removed |
| 164 cal/cm ² | Arc Flash at 18 inches |
| Dangerous | No FR Category Found |
| 00 | Glove Class |
| 361 inch | Arc Flash Boundary |
| 48 inch | Limited Approach |
| 12 inch | Restricted Approach |
| 1 inch | Prohibited Approach |
| <small>May 2009</small> | |
| <small>Bus: CHILLER SUB LINE Prot: Max Trip Time (3.0s)</small> | |

16

Equipment Labeling: 130.5(C)

This information must be included in the field marking:

1. At least one of the following:
 - Available incident energy and the corresponding working distance
 - Minimum arc rating of clothing
 - Required level of PPE
 - Highest Hazard/Risk Category (HRC) for the equipment

2. Nominal system voltage

3. Arc Flash Boundary

Note:

Labels applied prior to September 30, 2011 are acceptable if they contain the available incident energy or required level of PPE.

17

Boundaries

- Because of these hazards, approach boundaries must be established to protect workers from exposure.

Shock Protection Boundaries –

Table 130.4 (C)(a)(b)

- Limited: *Unqualified with escort only, must use PPE*
- Restricted: *Qualified workers only*
- Prohibited: *Working distance*

Flash Protection Boundary- Based on the distance at which the available energy level is above the threshold for a second degree burn.

18



Qualified Person

OSHA - A person who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training and experience, successfully demonstrated the ability to solve/resolve problems relating to the subject matter, the work, or the project.

NFPA 70E - A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

Such persons shall also be familiar with the proper use of the special precautionary techniques; personal protective equipment including:

- **arc flash suit**
- **insulating and shielding materials**
- **insulated tools**
- **test equipment**

19

Training Requirements

Safety Training:

- The training requirements shall apply to workers who are exposed to electrical hazards.
- They shall be trained in safety-related work practices and procedures which provide protection from the electrical hazards associated with their job.
- *Workers shall be trained to identify and understand electrical hazards and possible injury.*

20



Emergency Procedures

- Employees exposed to shock hazards and those employees responsible for taking action in case of emergency shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts.
- Employees shall be regularly instructed in methods of first aid and emergency procedures, such as approved methods of resuscitation.
- Training of employees in cardiopulmonary resuscitation and automatic external defibrillator (AED) use, shall be certified by the employer annually.

21

Retraining Requirements

- An employee shall receive additional training (or retraining) under any of the following conditions:
- The employee is not complying with the safety-related work practices.
- If changes in procedure are different from those that the employee would normally use.
- Retraining shall be performed at intervals not to exceed 3 years.

22



Electrical Safety Program

Awareness and Self-Discipline.

- The electrical safety program shall be designed to provide an **awareness** of the potential electrical hazards to those who work in an environment with the presence of electrical hazards.
- The program shall be developed to provide the required **self discipline** for all employees who must perform work that may involve electrical hazards.

23

Job Briefing

Before starting each job, the employee in charge shall conduct a job briefing with the employees involved.

Subjects to be covered:

- **Associated hazards**
- **Work procedures**
- **Special precautions**
- **Energy source controls**
- **PPE requirements**

24



Use of Equipment

Simply operating an on/off control device is not sufficient to disconnect electrical equipment or circuits.

- The system must then be tested for the absence of voltage.
- Employees shall be trained to select an appropriate voltage detector and shall understand all limitations of each specific voltage detector that might be used.
- Section 110.4 covers the ratings and design of test instruments and equipment.



25

Testing Procedure

- **Treat circuit parts as energized until verified.**
- Remember the three steps in “**Live - Dead - Live**” test procedure:
 1. Test a known energized circuit operating at the same voltage first.
 2. Test the circuit thought to be de-energized.
 3. Re-test the known energized circuit to verify meter operation.
- When exposed to energized electrical conductors, appropriate protective equipment must be used.



26

Work Involving Electrical Hazards

- Energized electrical conductors and circuit parts shall be put into an electrically safe work condition (**zero energy**) before an employee works on them if the worker is within the safe approach boundaries.
- **Zero Energy** means that all residual energy must be dissipated and means must be employed to prevent buildup until controls are removed.
- Examples include: work with capacitors and components subject to induced energy.
- Apply lockout/tagout devices in accordance with an established policy to control the source.

27

Electrically Energized Work

- Energized work shall be permitted when:
- The employer can demonstrate that de-energizing introduces additional hazards, such as interrupting life support equipment.
- The employer can demonstrate that the task to be performed is infeasible in a de-energized state due to equipment design or operational limitations.
- Tasks such as troubleshooting and testing energy levels are examples of permissible energized work.

28



Energized Electrical Work Permit

- When working on energized electrical conductors or circuit parts that are not placed in an **electrically safe** work condition, work to be performed shall be performed by written permit only.
- A sample of this permit may be found in Informative Annex J.
- Work performed on or near live parts by qualified persons related to tasks such as **testing, troubleshooting, voltage measuring, etc...** shall be permitted to be performed without an energized electrical work permit, provided appropriate safe work practices and personal protective equipment are provided and used.

29

Hazard Analysis

- Either Table 130.7(C)(15)(a) or the incident energy analysis of 130.3(B), may be used to determine the hazard/risk category, and requirements for use of rubber insulating gloves and insulated hand tools for a task.
- These category classifications are based on:
 - **Type of equipment**
 - **Nominal voltage ratings**
 - **Specific task to be performed**



30

Voltage Rated Gloves: Required for all voltage testing on exposed parts.

| Rating | Class |
|-------------|-------|
| 500 volts | "00" |
| 1000 volts | "0" |
| 7500 volts | "1" |
| 17000 volts | "2" |

Voltage Rated Gloves :

- must be inspected before each use for cracks, wear spots and pin holes / punctures.
- must be stored in a protective bag designed for the purpose, and kept clean.
- must be professionally tested before first use and then at six month intervals.
- test records must be maintained.



Rule of Thumb: Rubber glove should extend beyond leather protector cuff by 1" per 10KV, which gives additional shock protection for the forearm.

31

HAZARD RISK CATEGORY 0

- **Protective clothing :**
- **Non-melting or Untreated Natural Fiber – untreated cotton, wool, rayon, or silk, or blends of these materials with a fabric weight of at least 4.5 oz/yd²**
- **Shirt (long sleeve)**
- **Pants (long)**
- **Protective Equipment :**
- **Safety glasses or safety goggles (selection required).**
- **Hearing Protection (ear canal inserts)**
- **Leather gloves (not required if voltage-rated gloves are used)**
- **Voltage-Rated gloves and insulated hand tools if applicable per Table 130.7 (C)(15)(a).**

NFPA 70E Table 130.7 (C)(16)

32

HAZARD RISK CATEGORY 1

- Clothing with a minimum Arc Rating of 4 cal/cm²

HAZARD RISK CATEGORY 2

- Clothing with a minimum Arc Rating of 8 cal/cm²

HAZARD RISK CATEGORY 3

- Clothing with a minimum Arc Rating of 25 cal/cm²

HAZARD RISK CATEGORY 4

- Clothing with a minimum Arc Rating of 40 cal/cm²

NFPA 70E Table 130.7 (C)(16)

33

Summary

- NFPA 70E offers electrical safety standard practices to protect workers from Shock, Flash, and Blast related to electrical energy.
- OSHA recognizes NFPA 70E as a resource for compliance with their regulations.
- Equipment must be labeled with information to identify the associated hazards.
- Electrical work must be performed in a de-energized state unless permitted by Section 130.2(A).
- A hazard analysis, job briefing, and energized work permit are all required to perform energized work.
- Only qualified workers may perform electrical work while exposed to the hazards.
- Qualified workers must follow established procedures and wear appropriate PPE while performing energized work.

34



**Questions
?**

The End



Safety Resources

- AISC Safety Website – www.aisc.org/safety
- Sample Safety Program Elements
- Safety Awards Program
- Sample Safety Forms
- Top 10 OSHA Citations
- OSHA Interpretations
- Safety Product Reviews
- Safety Details or 'Tool Box Talks'
- Daily Safety Focus
- And more



AISC Safety

Safety Awards Program

- Annual award to recognize fabricators and erectors that demonstrated safe working practices.
- There are different levels of the award. The most basic award is given to those who achieved a DART (days away, restricted, or transfer) rate between 1.01 and 2.00. The highest award is given to those who had a perfect safety record for the given year.
- Companies must submit a Safety Reporting Form and must have submitted at least 2 consecutive years prior to the award year to be eligible to receive an award (the DART rate of those 2 previous years does have an effect on the current year's standing). This requirement helps us maintain more accurate and representative statistics.



AISC Safety

Feedback & Future Safety Webinars

- Please help provide feedback to this webinar so we can improve future webinars
- Brief survey at the conclusion of today's webinar.
- Our next webinar will be on Globally Harmonized System (GHS).

Additional comments? Send to:

Jie Zuo
zuo@aisc.org



AISC Safety

Thank You

American Institute of Steel Construction
One East Wacker Drive, Suite 700
Chicago, IL 60601

There's always a solution in steel.

There's always a solution in steel.

