This training course was produced under grant number SH-1942-09-06-F13 from OSHA, USDOL. It does not necessarily reflect the views or policies of the US Department of Labor, nor does mention of trade names, commercial products, or organizations imply endorsement by the US Government.

**LEARNING OBJECTIVES:**

- Why Electrical Safety and Arc Flash Protection?
- What is electrical safety?
- What does electrical safety consist of?
- What does electrical safety look like?
- How does electrical safety apply to your workplace?
- Which standards apply to electrical safety?
- How to Recognize Electrical Hazards in the Workplace
Arc Flash Injuries
- Electric shock
- Severe burns
- Blindness
- Blast injuries
  - Shrapnel wounds
  - Lung blast injuries
  - Ruptured eardrums
  - Pressure wave injuries

Severity Factors
- **Power** – amount of energy at the arc
- **Distance** – of the worker to the arc
- **Time** – duration of the arc exposure

Arc Flash

Electric Shock Injury – Burn

Severe Burns from Arc Flash

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc flash</td>
<td>up to 35,000°F</td>
</tr>
<tr>
<td>Sun</td>
<td>9,900°F</td>
</tr>
</tbody>
</table>
Blindness
Flash of light is so intense it can damage vision.

Shrapnel Wounds
Material and molten metal can hit the body at over 700 miles per hour.

Blast Lung Injury (BLI)
Arc blast can cause inhalation injuries. For example:
- Inhaling high temperature copper vapor
- More than 100 toxic substances can be found in the fumes.

BLI + Burns = Greater chance of death

Hearing Damage

<table>
<thead>
<tr>
<th>Source</th>
<th>Decibels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc blast at 2 feet</td>
<td>145</td>
</tr>
<tr>
<td>Jet engine at 200 feet</td>
<td>132</td>
</tr>
<tr>
<td>Pain threshold</td>
<td>130</td>
</tr>
</tbody>
</table>

Pressure Wave Injuries
Arc blast can throw a worker:
- Off a ladder
- Into nearby walls or equipment.

2000 lbs/ft² pressure on the body can cause:
- Concussion
- Collapsed lungs
- Other internal injuries

What is Electrical Safety
What is Electrical Safety

Protecting workers from the unexpected start-up, or unexpected reenergization of equipment, circuits, or parts while maintenance is being performed. Protecting workers from exposure to live electrical parts.

Includes overhead and underground electrical distribution, including systems, equipment, circuits, and parts.

IT IS MANDATORY!

Documented Electrical Safe Work Practices

Programs

Selection, Use, Maintenance, Storage of Proper PPE

Employee Training

Who’s Responsible for Safety?

• The “Employer” is responsible for
  • OSHA requirements
  • Electrical Safety Program
  • Safety Policies and Procedures
  • Safety Training

• The “Employee” is responsible for
  • Implementing procedures

• The “Owner” is inherently responsible for
  • Contractors on site

Which Standard Applies?

OSHA or NFPA 70E

Don’t forget … OSHA solicited the services of the NFPA to establish new rules and regulations in a standard that OSHA could choose to enforce. (Mid 1990’s).

• This became known as NFPA 70E – 2000.

What Does Electrical Safety Look Like?

Lockout Tagout
### Gloves

- Materials were developed under NFPA 70E 2009 Ed

### Dated Insulated Gloves

- Materials were developed under NFPA 70E 2009 Ed

### Leather Gloves

- Materials were developed under NFPA 70E 2009 Ed

<table>
<thead>
<tr>
<th>CLASS</th>
<th>PROOF VOLTAGE</th>
<th>COLOR</th>
<th>MAX USE Volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>OO</td>
<td>1,000</td>
<td>BEIGE</td>
<td>500</td>
</tr>
<tr>
<td>O</td>
<td>5,000</td>
<td>RED</td>
<td>1,000</td>
</tr>
<tr>
<td>1</td>
<td>10,000</td>
<td>WHITE</td>
<td>7,500</td>
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<tr>
<td>2</td>
<td>20,000</td>
<td>YELLOW</td>
<td>17,000</td>
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<tr>
<td>3</td>
<td>30,000</td>
<td>GREEN</td>
<td>26,500</td>
</tr>
<tr>
<td>4</td>
<td>40,000</td>
<td>ORANGE</td>
<td>36,000</td>
</tr>
</tbody>
</table>

### Voltage Rated Gloves & Tool Testing

- MSHA Requires testing yearly
- OSHA Requires testing every 6 month
- Tested date is marked on gloves, equipment and hot sticks
- Must be inspected and field tested before each use (visual and roll-up test)

### Article 130 Working On or Near Live Parts

- **130.7 Personal and Other Protective Equipment.**
  - (C) Personal Protective Equipment.
  - (13) Arc Flash Protective Equipment.
  - (c) Hand Protection. Leather or FR gloves shall be worn where required for arc flash protection. Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over rubber gloves.
Does not meet requirements of 120.1(5) – NFPA 70E

Materials were developed under NFPA 70E 2009 Ed

Meter Safety – Does meet requirements of 120.1(5) – NFPA 70E

CAT III-600 V
CAT IV -1000V

CAT III-600 V
CAT IV-1000 V

CAT III-600 V

How Does Electrical Safety Apply to Your Workplace

Materials were developed under NFPA 70E 2009 Ed

Voltage Rated Tools

Materials were developed under NFPA 70E 2009 Ed

What Voltages are Present?

120V
480V
4160V

What Voltages are Present?

• 7.2KV
• 13.8KV
• 14.4KV

Materials were developed under NFPA 70E 2009 Ed
What Voltages are Present?

- 20KV
- 138KV
- 345KV
- 500KV
- 750KV

Based on Voltages & Hazards Present - Establish Procedures

- Determine Voltage & Arc Flash Hazards
- Determine Who is Exposed
- Determine Protective Measures
- Determine OSHA Requirements
- Determine What NFPA 70E Procedures that Will be Followed

Which Standards Apply?

OSHA

- 1910.269 Over 600 Volts
- 1910.331-335 600 Volts or Less
- 1910.132(d) Hazard Assessment
- 1910.137 PPE

NFPA 70E – 2009 Edition
Which Standard Applies?
OSHA or NFPA 70E

**OSHA**
- 1910.331-335 600 Volts or Less
- 1910.269 Over 600 Volts

Herein lies the challenge.
- OSHA 1910.335 Safeguards for personnel.
  - (a) Use of protective equipment
  - (1) Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for work to be performed.

Herein lies the challenge.
- NFPA 70E. Section 130.7(A)
  Personal and Other Protective Equipment
  (A) General.
  (1) Employees working in areas where electrical hazards are present shall be provided with, and shall use, electrical protective equipment that is designed and constructed for the specific part of the body to be protected and for work to be performed.

Herein lies the challenge.
- OSHA 1910.335 Safeguards for personnel.
  - (a) Use of protective equipment
  - Issue: When OSHA has an existing standard, OSHA cannot incorporate another standard by reference which addresses the same material. This is the case with 1910.335(a)(1).

Herein lies the challenge.
- OSHA 1910.335 Safeguards for personnel.
  - (a) How to comply?
  - Suggested solution, which OSHA believes to be in compliance with their requirements...
  - NFPA 70E – 2009 when available.

Herein lies the challenge.

Conclusion.
- Comply with OSHA 1910.335 Safeguards for personnel by following the information contained in...

Materials were developed under NFPA/IEEE 2009 Ed
Let’s Complicate Things a Bit More ...

Is There More...

Answer

• 1. The employers rules.
• 2. OSHA rules.
• 3. NFPA 70E or other appropriate standard.

Management, Be Smart !!!!!!!!!!

Establish sound company rules and regulations for safety & mandate compliance to the letter.

AVOID “CONTRIBUTORY NEGLIGENCE”
or “INDEPENDENT EMPLOYEE ACTION”

Employees, Be Smart !!!!!!!!!!

• Follow your company’s rules and regulations for safety to the letter.

• AVOID SERIOUS INJURY & DAMAGE

Article 110 of NFPA 70E - 2004

• SAFETY-RELATED WORK PRACTICES

• 110.4 Multiemployer Relationship

Outside Personnel (Contractors, etc) And Host must inform of: hazards, PPE, work practices, and emergency procedures.

• Must be documented and discussed.

How to Recognize Electrical Hazards in the Workplace

What is an Electric Arc?

An electric arc is a short circuit through the air.
Characteristics of an Electric Arc

• An electric arc will oscillate and escalate if not constrained.
• A single-phase electric arc can engulf a second or third conductor in only two cycles.
• An electric arc’s current propels the arc away from the power source.

What Causes Arc Flash?

• Dust, impurities, corrosion, condensation, animals
• Spark discharge from:
  • Accidental touching
  • Dropping tools
• Over-voltages across narrow gaps
• Failure of insulating materials
• Equipment failure

What is Arc Blast?

The flash causes an explosive expansion of air and metal.
  - For example: When copper vapourizes it expands by a factor of 67,000.

The blast produces dangerous:
  - Pressure waves
  - Sound waves
  - Molten steel and shrapnel.

Forms of Arc Flash Energy

• Noise
• Expansion
• Vaporization
• Thermal radiation

Human Body Resistance

• Hand to hand resistance = 1000 ohms
• 120 VAC circuit
• Ohms Law formula;
  • \[ I = \frac{E}{R} \]
  • \[ \frac{120}{1000} = 0.120 \text{ amps} \] (120 milliamps)

Human Body Resistance

Human body resistance (hand to hand) across the body is about 1000Ω.

\[ \text{Ohms Law: } I = \frac{V}{R} \text{ (Amps.)} \]
\[ V = 480 \text{ volts} / 1000 \Omega \]
\[ = 0.480 \text{ amps} (480 \text{ mA}) \]

The National Electrical Code® considers 5 mA to be the safe upper limit for children and adults.
Human Body Resistance

- Shock
  - electricity travels in closed circuits
  - shock occurs when the body becomes part of the electrical circuit
  - (1) short circuit
  - (2) ground fault
  - (3) metallic part of enclosure becomes energized

- Shock
  - Current: Not Voltage causes Electric Shock
    - 0.5 - 3 mA - Tingling sensations
    - 3 - 10 mA - Muscle contractions and pain
    - 10 - 40 mA - “Let-go” threshold
    - 30 - 75 mA - Respiratory paralysis
    - 100 - 200 mA - Ventricular fibrillation
    - 200 - 500 mA - Heart clamps tight
    - 1500 + mA - Tissue and Organs start to burn

Human Body Resistance

- The Severity of Shock affected by:
  - amount of current
  - path of the current
  - length of time
  - The severity of the shock can cause tremendous damage than is visible.

- Most common= Burns
  - Three types of burns
    - electrical
    - arc
    - thermal contact
  - Electrical burns are the result of current flowing through the tissues or bones

Materials were developed under NFPA/IEC 2009 Ed

Human Body Resistance

- Shock, (ohms)
  - Dry
  - Wet
  - Finger Touch: 40,000 to 1,000,000
  - Hand holding Wire: 15,000 to 50,000
  - Finger-Thumb Grasp: 10,000 to 30,000
  - Hand holding pliers: 5,000 to 10,000
  - Palm Touch: 3,000 to 8,000
  - Hand around 1 1/2 Pipe: 1,000 to 3,000
  - Two Hands around 1 1/2 Pipe: 500 to 1,500
  - Hand Immersed: 200 to 500
  - Foot Immersed: 100 to 300
  - Human Body, internal, excluding skin: 200 to 1,000

This Table was compiled from data developed by Kouwenhoven and Milnor

Human Body Resistance

- SKIN
  - outer layer of skin “horny layer” provides resistance to electricity but varies from individual to individual

- HEART
  - controlled by internal electrical impulses and disturbed by outside electrical impulses causing fibrillation and halting of pumping action. Death can quickly occur.

- MUSCLE
  - also controlled by electrical impulses
  - shock can result in loss of muscular control and lack of ability to release an electrical conductor

Humans Body Resistance continued....

Note: Reaction will vary with frequency and time of exposure under NFPA/IEC 2009 Ed
You know about shock, don’t forget ...

- **Arc**
  - arc burns make up a large portion of the injuries from electrical malfunction
  - electrical arcs can occur due to poor electrical contact or failed electrical insulation
- **Blast**
  - pressure developed by the near instantaneous heating of the air surrounding the arc and from the expansion of the metal as it is vaporized

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**Electrical Arc**

- 35,000 °F
- Molten Metal
- Pressure Waves
- Sound Waves
- Shrapnel
- Hot Air - Rapid Expansion
- Intense Light

**Copper Vapor:**
- Solid to Vapor
- Expands by 67,000 times

**Molten Metal**

**Hot Air - Rapid Expansion**

---

**Electrical Arc Burn Hazards**

**Some Temperature & Heat Data**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curable Burn Temperature (1/10th Sec.)</td>
<td>140°F</td>
</tr>
<tr>
<td>Cell Death Temperature (1/10th Sec.)</td>
<td>200°F</td>
</tr>
<tr>
<td>Temperature At Arc Terminals</td>
<td>35,000°F</td>
</tr>
<tr>
<td>Temperature Of Sun’s Surface</td>
<td>9,000°F</td>
</tr>
<tr>
<td>Temperature Of Burning Clothing</td>
<td>1,400°F</td>
</tr>
<tr>
<td>Clothing Ignition Temperature</td>
<td>700°F to 1,400°F</td>
</tr>
<tr>
<td>Temperature Of Metal Droplets</td>
<td>1,800°F</td>
</tr>
</tbody>
</table>

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**Electrical Arc Burn Injuries**

- Occur from high temperature sources
- Deep and slow to heal
- Involve large areas of body
- Distance from arc determines severity

---

Do You Have Any Equipment Such As...
Do You Have Any Plant or Construction Electrical Voltage or Arc Flash Hazards Such As…
How to Establish a Electrical Safe Work Condition

Best Solution - Take Equipment to a Zero Energy State and Lock it Out

The Most Electrical Dangerous Jobs
Remove Bolted Cover

The Next Level Down

Dangerous Electrical Jobs
Before Starting Work On or Near Energized Parts

1. Design Electrical Systems for Safety
2. Use Appropriate Voltage Rated Insulated Tools
3. Use Appropriate PPE, including FR Clothing

Insulated Screwdrivers

How to Evaluate Voltage & Arc Flash Hazard Potential
Before Work Can Proceed On or Near Exposed Energized Parts

We Must Perform:

- Shock Hazard Analysis
- Shock Protection Boundary
- Arc Flash Analysis
- Arc Flash Boundary

Calorie Studies vs. Tables

Calorie Studies
Performed by Professionals
Determines Exact Hazards
Costly
Tables
Can be Used Effectively
Must Know How to Navigate
Can Use to Select Proper PPE

Limited Approach Boundary

The **limited approach boundary** is a shock protection boundary to be crossed by only qualified persons (at a distance from a live part) which is not to be crossed by unqualified persons unless escorted by a qualified person.

Restricted Approach Boundary

A **restricted approach boundary** is a shock protection boundary to be crossed only by qualified persons (at a distance from a live part) which, due to its proximity to a shock hazard, requires the use of shock protection techniques and equipment when crossed.

Prohibited Approach Boundary

A **prohibited approach boundary** is a shock protection boundary to be crossed only by qualified persons (at a distance from a live part) which, when crossed by a body part or object shall require the same protection as if direct contact is made with a live part.
Default Flash Protection Boundary

- 600 volt systems = 4 feet (Ralph Lee Formulae)
- Above 600 volt systems = distance at which 1.2 cal/cm² (slow clearing time)
- Above 600 volt systems = distance at which 1.5 cal/cm² (clearing time of 0.1 sec or less)

Selecting Flash Protection

1. Calculate incident energy and select PPE based upon that calculation.
2. Select hazard/risk category based on task, then select PPE based upon hazard/risk category.

Materials were developed under NFPA 70E 2009 Ed

Label Electrical Systems

NFPA 70E

PPE Selection
Use of Tables Exercise

Label Electrical Systems

Label Electrical Systems

Label Electrical Systems
Materials were developed under NFPA 70E 2009 Ed

Label Electrical Systems

Selecting Flash Protection

Section 130.3

4’- 0” IS THE NUMBER. If you do not know the fault current available, this number may work. Dupont, Alcoa, Kaiser, SHELL OIL, company use it!!!!!

Materials were developed under NFPA 70E 2009 Ed

PPE-OSHA, 1910.132(a)

- Protective equipment, including personal protective equipment for eyes, face, head, and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used, and maintained in a sanitary and reliable condition wherever it is necessary by reason of hazards of processes or environment, chemical hazards, radiological hazards, or mechanical irritants encountered in a manner capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical contact.

Materials were developed under NFPA 70E 2009 Ed

PPE-Employee Owned

- Employee-owned equipment. Where employees provide their own protective equipment, the employer shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.

Materials were developed under NFPA 70E 2009 Ed
Why do you need a FR Clothing Program?

- Why do you need to pay attention to NFPA 70E and OSHA requirements for employee protection?
- Check out the cost comparison.
- Examples from Steel Grip

Why do you need a FR Clothing Program? Ex 1

- Accident cost before FR program
  - Medical $812,677.00
  - Indemnity 773,613.00
  - Vocational 9,948.00
  - Expenses 931.00
  - TOTAL $1,597,229.00

Why do you need a FR Clothing Program? Ex 1

- Accident cost AFTER implementing FR program
  - Medical $9,213.00
  - Indemnity 1,890.00
  - Vocational 1,195.00
  - Expenses 10.00
  - TOTAL $12,308.00

Arc Flash Rated Face Shield
Materials were developed under NFPA 70E 2009 Ed.

Balaclava Sock Hood

Materials were developed under NFPA 70E 2009 Ed.

Materials were developed under NFPA 70E 2009 Ed.

Materials were developed under NFPA 70E 2009 Ed.

Materials were developed under NFPA 70E 2009 Ed.

Materials were developed under NFPA 70E 2009 Ed.

Materials were developed under NFPA 70E 2009 Ed.
How to Perform Work on or Near Energized Parts

Materials were developed under NFPA 70E 2009 Ed

Meter Safety—This is EXACTLY the WRONG way to do it!!!!!!!!

Materials were developed under NFPA 70E 2009 Ed

Meter Safety—This is EXACTLY the WRONG way to do it!!!!!!!!

Materials were developed under NFPA 70E 2009 Ed

What Does the Code State?

Article 130

Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • (A) General.
  • (B) Care of Equipment.
  • (C) Personal Protective Equipment.
  • (D) Other Protective Equipment.
  • (E) Alerting Techniques.
  • (F) Standards for Other Protective Equipment.

Materials were developed under NFPA 70E 2009 Ed

Materials were developed under NFPA 70E 2009 Ed

Article 130

Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • (A) General.
  • Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Materials were developed under NFPA 70E 2009 Ed
Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
• Care of Equipment.
  • Protective equipment shall be maintained in a safe, reliable condition.
  • The protective equipment shall be visually inspected before each use.

• Movement and Visibility.
  • When flame-resistant (FR) clothing is worn to protect an employee:
    • cover all ignitable clothing; and
    • allow for movement and visibility.

• Head, Face, Neck, and Chin Protection.
  • Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from electrical explosion.

• (C) Personal Protective Equipment.
  • (4) Eye Protection. Employees shall wear protective equipment for the eyes whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from electrical explosion.

Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • General
    • When an employee is working within the Flash Protection Boundary he/she shall wear protective clothing and other personal protective equipment in accordance with 130.8.
Article 130
Working On or Near Live Parts

- 130.7 Personal and Other Protective Equipment.
- (C) Personal Protective Equipment.
- (5) Body Protection. Employees shall wear FR clothing whenever there is a possible exposure to an electric arc flash above the threshold incident-energy level for a second-degree burn, 5 J/cm² (1.2 cal/cm²).

This is closer to what it should look like!
This is what NFPA 70E suggests, and what OSHA expects!
OSHA 1910.335(a)(1)(i)
NFPA 70E Table 3-3.9.1 / 3-3.9.2

This is how it SHOULD be done!!!!!!!!!!

Article 130
Working On or Near Live Parts

- 130.7 Personal and Other Protective Equipment.
- Arm and Hand Protection:
  - Employees shall wear rubber insulating gloves where there is a danger of hand and arm injury from electric shock due to contact with live parts.

Materials were developed under NFPA 70E 2009 Ed

Materials were developed under NFPA 70E 2009 Ed

Article 130
Working On or Near Live Parts

- 130.7 Personal and Other Protective Equipment.
  - Foot and Leg Protection. Where insulated footwear is used as protection against step and touch potential, dielectric overshoes shall be required. Insulated soles shall not be used as a primary electrical protection.

Materials were developed under NFPA 70E 2009 Ed

Article 130
Working On or Near Live Parts

- 130.7 Personal and Other Protective Equipment.
  - Standards for Personal Protective Equipment. Personal protective equipment shall conform to the standards given in Table 130.7(C)(8).
Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • Selection of personal protective Equipment. When selected in lieu of the flash hazard analysis of 130.3(A), Table 130.7(C)(9)(a) shall be used to determine the hazard/risk category for a task. For tasks not listed a flash hazard analysis is required.

Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • Protective Clothing and Personal Protective Equipment Matrix. Once the Hazard/Risk Category has been identified, Table 130.7(C)(10) shall be used to determine the required personal protective equipment (PPE) for the task.

Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • (C) Personal Protective Equipment.
    • (11) Protective Clothing Characteristics. Table 130.7(C)(11).

Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • (C) Personal Protective Equipment.
    • (12) Factors in Selection of Protective Clothing. Clothing and equipment that provide worker protection from shock and arc flash hazards shall be utilized. Clothing and equipment required for the degree of exposure shall be permitted to be worn alone or integrated with flammable, nonmelting apparel.

Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • Factors in Selection of Protective Clothing cont’d.
    • If FR clothing is required, it shall over associated parts of the body as well as all flammable apparel while allowing movement and visibility.

Article 130
Working On or Near Live Parts

• 130.7 Personal and Other Protective Equipment.
  • Layering: Non-melting, flammable fiber garments shall be permitted to be used as under layers in conjunction with FR garments in a layered system for added protection.
• 130.7 Personal and Other Protective Equipment.

Layering cont’d. If non-melting, flammable fiber garments are used as under layers, the system arc rating shall be sufficient to prevent break-open of the innermost FR layer at the expected arc exposure incident energy level to prevent ignition of flammable under layers.

Materials were developed under NFPA 70E 2009 Ed

• Outer Layers. Garments worn as outer layers over FR clothing, such as jackets or rainwear, shall also be made from FR material.

Materials were developed under NFPA 70E 2009 Ed

• Under layers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric under layers (underwear) next to the skin.

Materials were developed under NFPA 70E 2009 Ed

• Coverage of FR Clothing:
  • Clothing shall cover potentially exposed areas as completely as possible.
  • Shirt sleeves shall be fastened at the wrists, and shirts and jackets shall be closed at the neck.

Materials were developed under NFPA 70E 2009 Ed

• Fit. Tight-fitting clothing shall be avoided. Loose-fitting clothing provides additional thermal insulation because of air spaces.

Materials were developed under NFPA 70E 2009 Ed

• Interference. The garment selected shall result in the least interference with the task but still provided the necessary protection.

Materials were developed under NFPA 70E 2009 Ed

• The work method, location, and task could influence the protective equipment selected.
Article 130
Working On or Near Live Parts

- 130.7 Personal and Other Protective Equipment.
- Arc Flash Protective Equipment.
- Flash Suits.
  - Flash suit design shall permit easy and rapid removal by the wearer.
  - The entire suit, including the hood’s face shield, shall have an arc rating that is suitable for the arc flash exposure.

Materials were developed under NFPA 70E 2009 Ed

Article 130
Working On or Near Live Parts

- 130.7 Personal and Other Protective Equipment.
- Arc Flash Protective Equipment.
- Face Protection must meet the following:
  - Face shield shall have an arc rating suitable for the arc flash exposure.
  - Face shields without an arc rating shall not be used.
  - Eye protection (safety glasses or goggles) shall always be worn under face shields/hoods.

Materials were developed under NFPA 70E 2009 Ed

The Left Hand Rule

Applies to both breakers and disconnects.
How to Establish an Electrical Safety Program

There are five objectives of an electrical safety program:

- Make personnel more aware of rules, responsibilities and procedures for working safely
- Demonstrate compliance with the federal law
- Document requirements and guidelines for providing a safe workplace free from unnecessary hazards
- Document requirements and guidelines to personnel, who could be exposed to electrical hazards
- Encourage, and make it easier for each employee to be responsible for his or her own electrical safety self-discipline.

THE IEEE YELLOW BOOK


SCOPE OF THE PROGRAM

Must address the needs of all employees, as well as contractors and visitors. (See NFPA 70E, Section 110.5)

ELECTRICAL SAFETY PROGRAM

A plan designed so that neither workplace conditions, nor the actions of people, expose personnel unnecessarily to electrical hazards.

CONTENT OF PROGRAM

- Management Commitment
- Organizational Support
- Electrical Safety Policy
CONTENT OF PROGRAM

Training and Qualification of Personnel
Use of Protective Equipment, Tools, and Protective Methods
Use of Electrical Equipment

CONTENT OF PROGRAM

Documentation
Oversight and Auditing
Technical Support
Emergency Preparedness

MANAGEMENT COMMITMENT

To be effective, an Electrical Safety Program must be strongly supported at the highest levels of management.

And, Establish A Budget

MANAGEMENT COMMITMENT

Management should first establish an electrical safety policy, and identify the line organization(s) to implement that policy.

ELECTRICAL SAFETY POLICY

• Electrically safe facilities shall be established and maintained
• All work involving electrical energy shall be performed in a safe manner

ORGANIZATIONAL SUPPORT

An Electrical Organization
A Safety Organization
An “Authority Having Jurisdiction” (for electrical safety concerns)
RESPONSIBILITIES OF THE ELECTRICAL SAFETY AUTHORITY

1. Take ownership of the Electrical Safety Program
2. Develop and revise company electrical safety standards
3. Provide interpretations of nationally recognized codes and standards

4. Provide guidance for facility configuration management
5. Resolve NFPA 70E and NEC inspection questions
6. Establish and document good safe work practices

7. Provide technical input for OSHA interpretations
8. Provide guidance for electrical training programs
9. Provide guidance for procedure preparation

10. Provide consultation services to management
11. Review electrical safety incidents and participate in investigations
12. Issue summaries and “lessons-learned” about electrical safety incidents
13. Evaluate non-listed electrical equipment, or know how to get an evaluation done

ELECTRICAL SAFETY POLICY

1. Electrically safe facilities shall be established and maintained
2. All work involving electrical energy shall be performed in a safe manner
PROVIDING AND MAINTAINING ELECTRICALLY SAFE FACILITIES

- Design for safety
- Installations according to appropriate “Codes” or standards
- Inspection of new and modified facilities
- Maintenance, preventive & breakdown
- Familiarity with recognized Standards
- Safety audits of workplace conditions

SAFE WORK PRACTICES

SAFE WORK PRACTICES

SAFEST BASIC RULE

Work on or near exposed live parts should be prohibited, except under justified, controlled, and approved circumstances.

SAFE WORK PRACTICES

- Safety training and qualifications
- Safety audits and self-assessments of personnel activities
- Use of oversight groups
- A technical authority to respond to questions regarding safe work practices

TRAINING AND QUALIFICATION OF ALL PERSONNEL

All personnel should have training appropriate to their tasks.

- Qualified persons need training on construction and operation of specific equipment, and the hazards involved. See definition of Qualified Person from NFPA 70E.
- Others need training in basic electrical safety awareness.

PROVIDING AND MAINTAINING ELECTRICALLY SAFE FACILITIES

- Training and qualifications for personnel
- A technical authority to respond to questions about design, installation and maintenance
- Organizational structures to accomplish the above tasks

(See Chapter 9 of Yellow Book)
USE OF PROTECTIVE EQUIPMENT, TOOLS, PROTECTIVE METHODS

HAVE A PLAN FOR THE UNEXPECTED

Just in case things go wrong, predetermine what protective equipment, tools, and protective methods should be used to reduce risk of injury during the performance of various tasks.

(See Chapter 11 of Yellow Book)

DOCUMENTATION

- Work Authorizations
- Standards, Practices, Procedures, and Guidelines
- Drawings
- Equipment Manuals, Inspection Records, Histories
- Audit Findings
- Training Records (including content)

OVERSIGHT and AUDITING

- Electrical Safety Self-Assessment
- Electrical Safety Audit by Others

TECHNICAL SUPPORT

- Corporate engineering department
- In-house engineering organization
- Outside consultants

EMERGENCY PREPAREDNESS

- All Electrical Workers should know first aid and CPR. See NFPA 70E, Section 110.6(C)
- Emergency Responders should know basic electrical safety awareness, care for electrical accident victims, and self-protective measures.

ELECTRICAL SAFETY PRINCIPLES

It’s Just 40 Little Words

Plan Every Job
Anticipate Unexpected Events
Identify the Hazard
Minimize the Hazard
Use Procedures as Tools
Use the Correct Tools for the Job Task
Use Personal Protective Equipment
Isolate the Equipment
Assess People’s Abilities
Protect the Person
Audit these Principles
CONCLUSIONS

- Anticipate the unexpected
- A plan is needed to reduce risks of injury
- There are many elements to consider for the plan
- Document the elements into an Electrical Safety Program

Protect Your Workforce

Materials were developed under NFPA 70E 2009 Ed

Electrical Safety Arc Flash/Blast Injury Prevention for Management

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