COPYRIGHT NOTICE

United States Laws and Federal regulations published as promulgated are public domain. Their compilation and arrangement, along with other materials, in this document are subject to the copyright notice. The intellectual property rights to certain papers and drawings contained within belong to Michael Kovacic.

All rights reserved. Neither the document nor any part thereof may be reproduced in any manner without the written permission of Michael Kovacic.

LIABILITY STATEMENT

Due to the constantly changing nature of government regulations, it is impossible to guarantee absolute accuracy of the material contained in this document. The author, editors and auxiliaries, therefore, cannot assume any responsibility for omissions, errors, misprinting, or ambiguity contained within this material and shall not be held liable in any degree for any loss or injury caused by such omission, error, misprinting or ambiguity presented in this paper.

This document is designed to provide reasonably accurate and authoritative information in regard to the subject matter covered. It is provided with the understanding that Michael Kovacic is not engaged in rendering legal or other professional service. If legal advice or other expert assistance is required, the services of a competent professional person should be obtained.

Michael Kovacic

mkovacic@oshazone.com

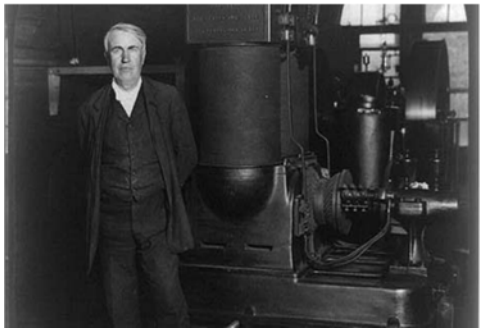
Copyright 2012

Fact, Fiction or Fad?

NFPA 70E is a NEW standard

- ☐ Fact
- ☑ Fiction
- ☐ Fad

Commercial use of electricity begins in the late 1800's…



…and the National Electrical Code was born out of a concern for property

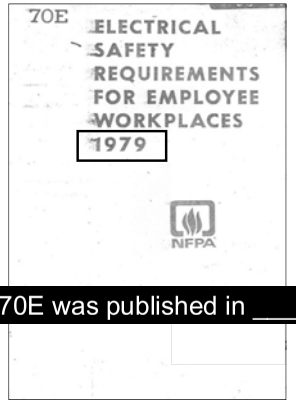
1968

OSHA eventually bases Subparts S and K on the National Electrical Code

1976

OSHA asks NFPA to develop a Safety Related Work Practices (SRWP) standard, known today as NFPA 70E – *Standard for Electrical Safety in the Workplace*

Eventually becomes 29 CFR 1910.331-.335



First 70E was published in _____?

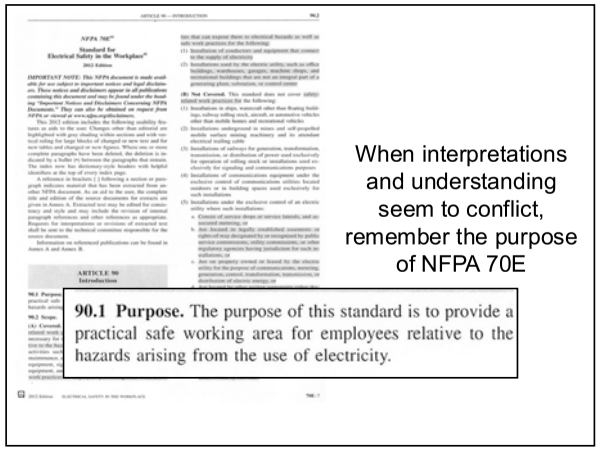
Fact, Fiction or Fad?

NFPA 70E is written by the lawyers, for the lawyers

- ☐ Fact
- ☑ Fiction
- ☐ Fad

NFPA 70E is a consensus standard

So who *writes* NFPA 70E?



NFPA 70E™
Standard for
Electrical Safety in the Workplace™
2012 Edition

ARTICLE 90
Introduction

90.1 Purpose. The purpose of this standard is to provide a practical safe working area for employees relative to the hazards arising from the use of electricity.

When interpretations and understanding seem to conflict, remember the purpose of NFPA 70E

Hazards of Electricity

- Shock
  - Direct/Indirect
  - Electrocution
- Burns
- Arc Flash/Blast
- Fire
- Explosions

Fact, Fiction or Fad?

Shock, electrocution and burn hazards are hyped up to sell more rubber-insulating goods.

- ☐ Fact
- ☑ Fiction
- ☐ Fad

Hazards of Electricity – Shock/Electrocution (Direct and Indirect Hazards)

- 1-5mA = Perception threshold
  - Able to feel the current
  - Reaction hazards
- 9-16mA = No-let go threshold
  - Lose ability to control voluntary and autonomic processes.
  - Unable to break contact
- 16-30mA = Respiratory failure
  - Lungs unable to work properly
  - Internal tissue heating

Current	Effect
1mA	Barely perceptible
1-5mA	Perception threshold
5-9mA	Painful sensations (involuntary reactions)
9-16mA	Muscular contraction (can't let go)
16-30mA	Biological issues (internal heating)
30-100mA	Respiratory paralysis Ventricular fibrillation Tissue burning

Hazards of Electricity – Shock/Electrocution (Direct and Indirect Hazards)

- 75mA = Heart Fibrillation (minimal)
  - Heart no longer pumps blood
  - CPR does not restore heart
- 250mA = Heart Fibrillation (common)
- 4-20A = Fatal Exposure
  - Serious tissue & organ damage
  - Internal burning

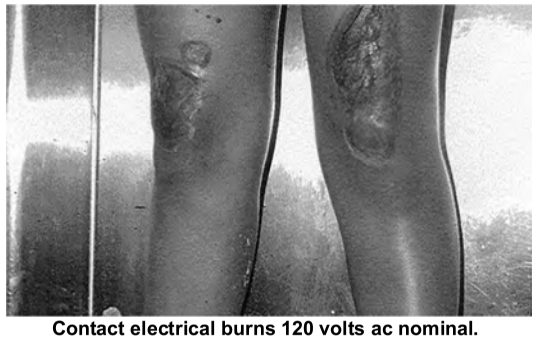
Current	Effect
1mA	Barely perceptible
1-5mA	Perception threshold
5-9mA	Painful sensations (involuntary reactions)
9-16mA	Muscular contraction (can't let go)
16-30mA	Biological issues (internal heating)
30-100mA	Respiratory paralysis Ventricular fibrillation Tissue burning

Common 100W light bulb = 750mA

Fact, Fiction or Fad?

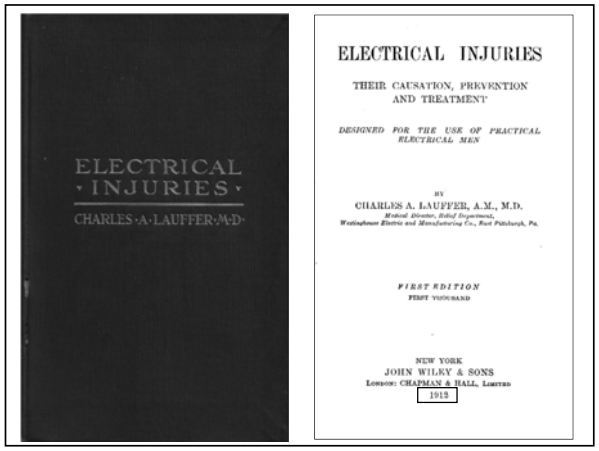
Electrical Safe Work Practices found in NFPA 70E only apply at high voltages.

- ☐ Fact
- ☑ Fiction
- ☐ Fad



Contact electrical burns 120 volts ac nominal. The right knee was the energized side and the left knee was ground.

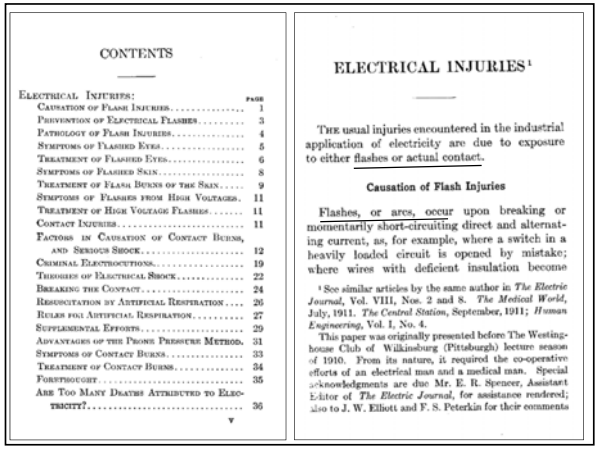
NFPA 70E and Subpart S require Electrical Safe Work Practices at 50V and Above!



Fact, Fiction or Fad?

Arc-Flash/Blast is a new hazard. They are buzzwords developed by salespersons to sell more PPE.

- ☐ Fact
- ☑ Fiction
- ☐ Fad



CONTENTS

ELECTRICAL INJURIES: PAGE
CAUSATION OF FLASH INJURIES 1
PREVENTION OF ELECTRICAL FLASHES 3
PATHOLOGY OF FLASH INJURIES 4
SYMPTOMS OF FLASHED EYES 5
TREATMENT OF FLASHED EYES 6
SYMPTOMS OF FLASHED SKIN 8
TREATMENT OF FLASH BURNS OF THE SKIN 9
SYMPTOMS OF FLASHES FROM HIGH VOLTAGES 11
TREATMENT OF HIGH VOLTAGE FLASHES 11
CONTACT INJURIES 11
FACTORS IN CAUSATION OF CONTACT BURNS, AND SERIOUS SHOCK 12
CRIMINAL ELECTROCUTIONS 19
THEORIES OF ELECTRICAL SHOCK 22
BREAKING THE CONTACT 24
RESUSCITATION BY ARTIFICIAL RESPIRATION 26
RULES FOR ARTIFICIAL RESPIRATION 27
SUPPLEMENTAL EFFORTS 29
ADVANTAGES OF THE PRONE PRESSURE METHOD 31
SYMPTOMS OF CONTACT BURNS 33
TREATMENT OF CONTACT BURNS 34
FORETHOUGHT 35
ARE TOO MANY DEATHS ATTRIBUTED TO ELECTRICITY? 36

v

ELECTRICAL INJURIES[1]

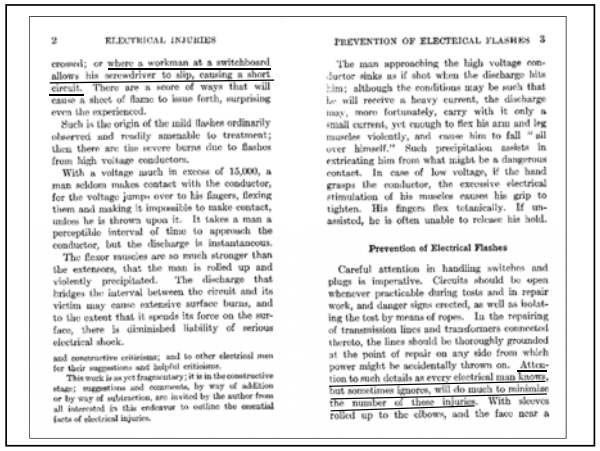
THE usual injuries encountered in the industrial application of electricity are due to exposure to either flashes or actual contact.

Causation of Flash Injuries

Flashes, or arcs, occur upon breaking or momentarily short-circuiting direct and alternating current, as, for example, where a switch in a heavily loaded circuit is opened by mistake; where wires with deficient insulation become

[1] See similar articles by the same author in *The Electric Journal*, Vol. VIII, Nos. 2 and 8. *The Medical World*, July, 1911. *The Central Station*, September, 1911; *Human Engineering*, Vol. I, No. 4.

This paper was originally presented before The Westinghouse Club of Wilkinsburg (Pittsburgh) lecture season of 1910. From its nature, it required the co-operative efforts of an electrical man and a medical man. Special acknowledgments are due Mr. E. R. Spencer, Assistant Editor of *The Electric Journal*, for assistance rendered; also to J. W. Elliott and F. S. Peterkin for their comments



2 ELECTRICAL INJURIES

crossed; or where a workman at a switchboard allows his screwdriver to slip, causing a short circuit. There are a score of ways that will cause a sheet of flame to issue forth, surprising even the experienced.

Such is the origin of the mild flashes ordinarily observed and readily amenable to treatment; then there are the severe burns due to flashes from high voltage conductors.

With a voltage much in excess of 15,000, a man seldom makes contact with the conductor, for the voltage jumps over to his fingers, flexing them and making it impossible to make contact, unless he is thrown upon it. It takes a man a perceptible interval of time to approach the conductor, but the discharge is instantaneous.

The flexor muscles are so much stronger than the extensors, that the man is rolled up and violently precipitated. The discharge that bridges the interval between the circuit and its victim may cause extensive surface burns, and to the extent that it spends its force on the surface, there is diminished liability of serious electrical shock.

and constructive criticisms; and to other electrical men for their suggestions and helpful criticisms.

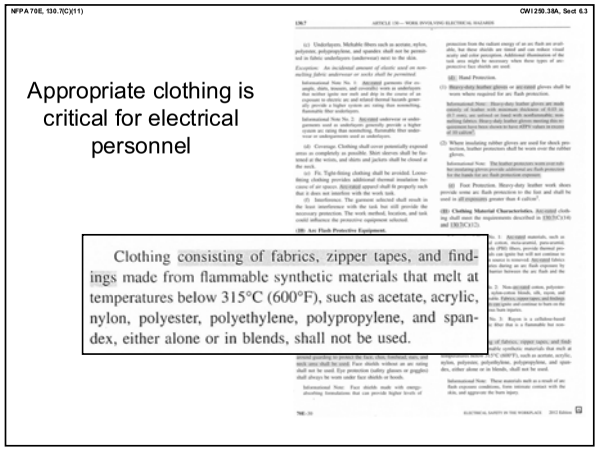
This work is as yet fragmentary; it is in the constructive stage; suggestions and comments, by way of addition or by way of subtraction, are invited by the author from all interested in this endeavor to outline the essential facts of electrical injuries.

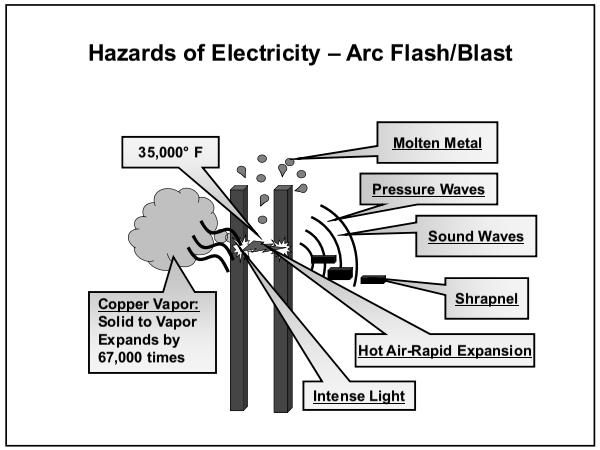
PREVENTION OF ELECTRICAL FLASHES 3

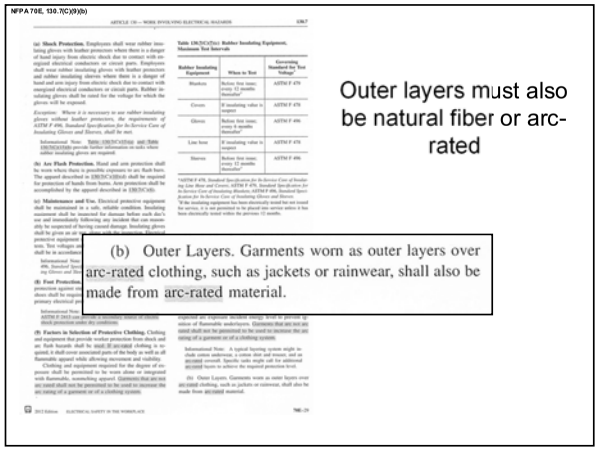
The man approaching the high voltage conductor sinks as if shot when the discharge hits him; although the conditions may be such that he will receive a heavy current, the discharge may, more fortunately, carry with it only a small current, yet enough to flex his arm and leg muscles violently, and cause him to fall "all over himself." Such precipitation assists in extricating him from what might be a dangerous contact. In case of low voltage, if the hand grasps the conductor, the excessive electrical stimulation of his muscles causes his grip to tighten. His fingers flex tetanically. If unassisted, he is often unable to release his hold.

Prevention of Electrical Flashes

Careful attention in handling switches and plugs is imperative. Circuits should be open whenever practicable during tests and in repair work, and danger signs erected, as well as isolating the test by means of ropes. In the repairing of transmission lines and transformers connected thereto, the lines should be thoroughly grounded at the point of repair on any side from which power might be accidentally thrown on. Attention to such details as every electrical man knows, but sometimes ignores, will do much to minimize the number of these injuries. With sleeves rolled up to the elbows, and the face near a







NFPA 70E, 130.7(C)(9)(c)

(c) Underlayers. Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric underlayers (underwear) next to the skin.

Exception: An incidental amount of elastic used on non-melting fabric underwear or socks shall be permitted.

Natural fiber or arc-rated clothing may not cover synthetic underlayers for electrical personnel

Fact, Fiction or Fad?

OSHA enforces electrical safe work practices found in NFPA 70E and references NFPA 70E

- ☑ Fact
- ☐ Fiction
- ☐ Fad

Fact, Fiction or Fad?

OSHA has adopted NFPA 70E

- ☐ Fact
- ☑ Fiction
- ☐ Fad

OSHA Investigations Leads to $148,500 in Penalties for Patrick Cudahy, Inc.

MILWAUKEE, Wis. -- Meat packing giant Patrick Cudahy, Inc., is facing $148,500 in fines proposed by the U.S. Labor Department's Occupational Safety and Health Administration (OSHA) following an inspection opened in May 2003 in response to reports of an industrial accident in which three employees were severely burned.

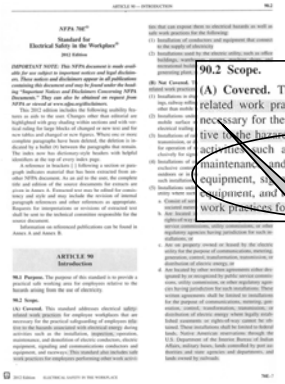
Three workers were reported to have been troubleshooting electrical switchgear at the Cudahy, Wis., facility when electricity arched and exploded. OSHA's investigation revealed that the three workers, all of whom received first, second and third degree burns throughout their bodies, **were not using insulated tools, were not wearing proper personal protective equipment, and were not following appropriate safety standards**. **OSHA issued willful and serious violations to Cudahy for allegedly failing to provide such equipment, and warning or training the workers about flash hazards.**

"The Labor Department's significant fine of $148,500 sends a message that this Administration will enforce safety and health standards for workers," said U.S. Secretary of Labor Elaine L. Chao.

Hazards of Electricity

Average of 350 workplace fatalities per year in the U.S. (DOL)

90.2 Scope



90.2 Scope.

(A) Covered. This standard addresses electrical safety-related work practices 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, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. *This standard also includes safe* work practices for employees performing other work activi-

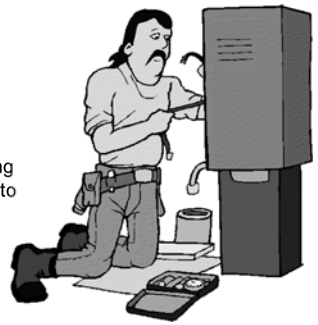
Necessary!

Who does these tasks?

Hazards of Electricity

60% Assumed to be authorized/qualified to perform electrical work

80% of the fatalities among qualified persons are due to arc-flash/blast incidents



90.2 Scope

90.2 Scope.

(A) Covered. This standard addresses electrical safety-related work practices 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, inspection, operation, maintenance, and demolition of electric conductors, electric equipment, signaling and communications conductors and equipment, and raceways. *This standard also includes safe* work practices for employees performing other work activi-

"electric equipment"

What does that mean?

Article 100 – Definitions

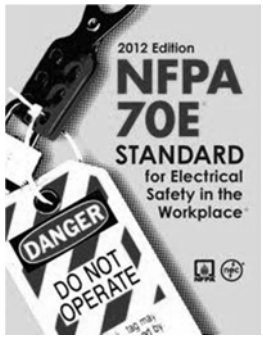
- **Equipment. A general term, including material, fittings, devices, appliances, luminaires, apparatus, machinery, and the like used as a part of, *or in connection with*, an electrical installation.**

So, who does this apply to?

***Before* working on or near…**

#1 Protection is…

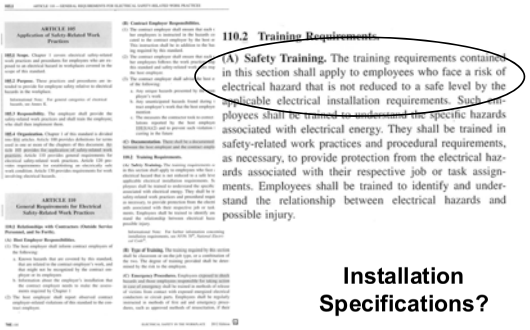
Protection through…



This Standard applies to

ALL employees!

110.2(A) – Training



110.2 Training Requirements.

(A) Safety Training. The training requirements contained in this section shall apply to employees who face a risk of electrical hazard that is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

Installation Specifications?

Installation Specifications

NFPA 70

1910.301-.308
1926.401-.408

110.4(B) – Portable Equipment

(C) Ground-Fault Circuit-Interrupter (GFCI) Protection.

(1) General. Employees shall be provided with ground-fault circuit-interrupter (GFCI) protection where required by applicable state, federal, or local codes and standards. Listed cord sets or devices incorporating listed GFCI protection for personnel identified for portable use shall be permitted.

(2) Outdoors. GFCI protection shall be provided when an employee is outdoors and operating or using cord- and plug-connected equipment supplied by 125-volt, 15-, 20-, or 30-ampere circuits. Where employees working outdoors operate or use equipment supplied by other than 125-volt, 15-, 20-, or 30-ampere circuits, an assured equipment grounding conductor program shall be implemented.

(D) Ground-Fault Circuit-Interrupter Protection Devices. GFCI protection devices shall be tested in accordance with the manufacturer's instructions.

2012 Change

110.4(B) – Portable Equipment

(3) Visual Inspection of Portable Cord- and Plug-Connected Equipment and Flexible Cord Sets.

(a) Frequency of Inspection. Before each use, portable cord- and plug-connected equipment shall be visually inspected for external defects (such as loose parts or deformed and missing pins) and for evidence of possible internal damage (such as a pinched or crushed outer jacket).

110.2(A) – Training

110.2 Training Requirements.

(A) Safety Training. The training requirements contained in this section shall apply to employees who face a risk of electrical hazard that is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

What are the specific hazards?

110.2(A) – Training

110.2 Training Requirements.

(A) Safety Training. The training requirements contained in this section shall apply to employees who face a risk of electrical hazard that is not reduced to a safe level by the applicable electrical installation requirements. Such employees shall be trained to understand the specific hazards associated with electrical energy. They shall be trained in safety-related work practices and procedural requirements, as necessary, to provide protection from the electrical hazards associated with their respective job or task assignments. Employees shall be trained to identify and understand the relationship between electrical hazards and possible injury.

In other words, the content of NFPA 70E and 1910.331-.335

100 – Qualified

Qualified Person. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved. [*70*, 2011]

What is a "qualified" person?

If you really want to know what a "qualified" person begins with, you have to look to the training section

110.2(D) – Qualified Training

(a) 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; and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but still be unqualified for others.

110.2(D) – Qualified Training

(1) Skills and techniques necessary to distinguish exposed energized electrical conductors and circuit parts from other parts of electrical equipment

110.2(D) – Qualified Training

(b) Such 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 all of the following:

In other words, persons who will perform live work.

110.2(D) – Qualified Training

(2) Skills and techniques necessary to determine the nominal voltage of exposed energized electrical conductors and circuit parts

110.2(D) – Qualified Training

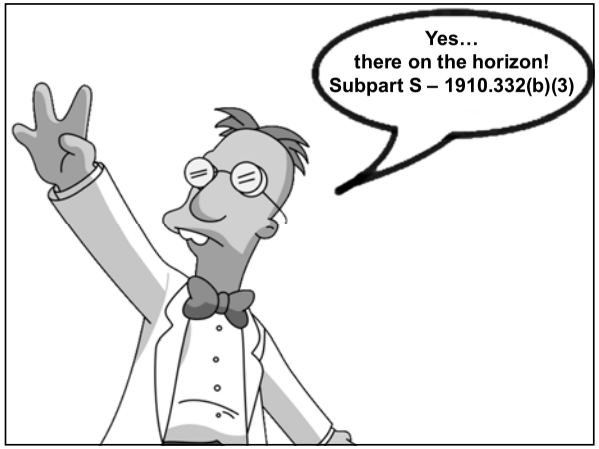
(3) Approach distances specified in Table 130.4(C)(a) and Table 130.4(C)(b) and the corresponding voltages to which the qualified person will be exposed

110.2(D) – Qualified Training

(4) Decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely

But wait……

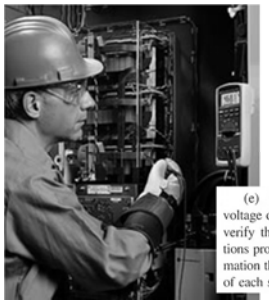
Don't those requirements sound vaguely familiar?



The OSHA regulations and NFPA 70E are attempting to accomplish the same thing…

Provide employees with a workplace free from recognized hazards

110.2(D) – Qualified Training



(e) Employees shall be trained to select an appropriate voltage detector and shall demonstrate how to use a device to verify the absence of voltage, including interpreting indications provided by the device. The training shall include information that enables the employee to understand all limitations of each specific voltage detector that might be used.

110.2(D)(1)(f) – Qualified Training

- **The employer shall determine through regular supervision or through inspections conducted on at least an annual basis, that each employee is complying with the safety-related work practices required by this standard.**

2012 Change

110.2(D)(3) – Qualified Training

- **Retraining shall be performed at intervals not to exceed 3 years.**

2012 Change

110.3(A) – Safety Program

The employer shall implement and document an overall electrical safety program that directs activity appropriate for the electrical hazards, voltage, energy level, and circuit conditions.

2009 Version

110.3(F) – Safety Program

(F) Hazard Identification and Risk Assessment Procedure. An electrical safety program shall include a hazard identification and a risk assessment procedure to be used before work is started within the limited approach boundary or within the arc flash boundary of energized electrical conductors and circuit parts operating at 50 volts or more or where an electrical hazard exists. The procedure shall identify the process to be used by the employee before work is started to identify hazards and assess risks, including potential risk mitigation strategies.

See Annex F

2012 Change

110.3(G) – Job Briefing

(G) Job Briefing.

(1) General. Before starting each job, the employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, personal protective equipment requirements, and the information on the energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work.

See Annex I

2012 Change

Annex I
Job Briefing and Planning Checklist

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.

I.1 Figure I.1 illustrates considerations for a Job Briefing and Planning Checklist.

Identify
- The hazards
- The voltage levels involved
- Skills required
- Any "foreign" (secondary source) voltage source
- Any unusual work conditions
- Number of people needed to do the job
- The shock protection boundaries
- The available incident energy
- Potential for arc flash (Conduct an arc flash-hazard analysis.)
- Arc flash protection boundary

Ask
- Can the equipment be de-energized?
- Are backfeeds of the circuits to be worked on possible?
- Is a "standby person" required?

Check
- Job plans
- Single-line diagrams and vendor prints
- Status board
- Information on plant and vendor resources is up to date
- Safety procedures
- Vendor information
- Individuals are familiar with the facility

Know
- What the job is
- Who else needs to know — Communicate!
- Who is in charge

Think
- About the unexpected event … What if?
- Lock — Tag — Test — Try
- Test for voltage — FIRST
- Use the right tools and equipment, including PPE
- Install and remove grounds
- Install barriers and barricades
- What else …?

Prepare for an emergency
- Is the standby person CPR trained?
- Is the required emergency equipment available? Where is it?
- Where is the nearest telephone?
- Where is the fire alarm?
- Is confined space rescue available?
- What is the exact work location?
- How is the equipment shut off in an emergency?
- Are the emergency telephone numbers known?
- Where is the fire extinguisher?
- Are radio communications available?

Figure I.1 Sample Job Briefing and Planning Checklist.

110.3(G) – Job Briefing

Routine Work. Prior to starting work, a brief discussion shall be satisfactory if the work involved is routine and if the employee is qualified for the task…

110.3(G) – Job Briefing

Repetitive or Similar Tasks. If the work or operations to be performed during the work day or shift are repetitive and similar, at least one job briefing shall be conducted before the start of the first job of the day or shift. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work.

Think this is too complicated?

It's only a "stop sign"…think about your work (look both ways) before you jump in!

110.3(H) – Safety Program

- **Electrical Safety Auditing.**
  (1) The electrical safety program shall be audited to verify the principles and procedures of the electrical safety program are in compliance with this standard. The frequency of audit shall not exceed 3 years.

2012 Change

110.3(H) – Safety Program

- **Electrical Safety Auditing.**
  (2) Field work shall be audited to verify that requirements contained in the procedures of the electrical safety program are being followed. When the auditing determines that the principles and procedures of the electrical safety program are not being followed, appropriate revisions to the training program or revisions to the procedures shall be made.

2012 Change

110.3(H) – Safety Program

- **Electrical Safety Auditing.**
  (3) The audit shall be documented.

2012 Change

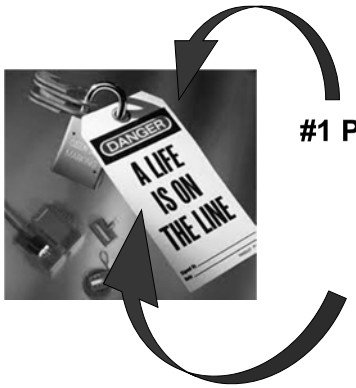
130.3(A)(1) – Work Conditions

Work is performed in one of TWO conditions:

- **Safe Work Condition.**

Accomplished by establishing an "Electrically Safe Work Condition"

While working on or near…



#1 Protection is…

LOTO

NFPA 70E Article 120 addresses establishing an "electrically safe work condition" beginning with six basic, minimum steps.

ARTICLE 120
Establishing an Electrically Safe Work Condition

120.1 Process of Achieving an Electrically Safe Work Condition. An electrically safe work condition shall be achieved when performed in accordance with the procedures of 120.2 and verified by the following process:

(1) Determine all possible sources of electrical supply to the specific equipment. Check applicable up-to-date drawings, diagrams, and identification tags.
(2) After properly interrupting the load current, open the disconnecting device(s) for each source.
(3) Wherever possible, visually verify that all blades of the disconnecting devices are fully open or that drawout-type circuit breakers are withdrawn to the fully disconnected position.
(4) Apply lockout/tagout devices in accordance with a documented and established policy.
(5) Use an adequately rated voltage detector to test each phase conductor or circuit part to verify they are de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the voltage detector is operating satisfactorily.

NFPA 70E Article 120 addresses establishing an "electrically safe work condition" beginning with six basic, minimum steps.

OSHA's 1910.333(b) also addresses LOTO.

NFPA 70E
Article 120

Minor 2012 Changes

130.3(A)(2) – Work Conditions

Work is performed in one of TWO conditions:

- **Safe Work Condition.**
- **Unsafe Work Condition.**

It's "Energized Work"!

130.3(B)(1) – Hazard Analysis

Energized work requires:

- **Shock Hazard Analysis.**
- **Flash Hazard Analysis.**

Sound complicated?

130.2(A) – Energized Work

130.2 Electrically Safe Working Conditions. Energized electrical conductors and circuit parts to which an employee might be exposed shall be put into an electrically

(1) Greater Hazard. Energized work shall be permitted where the employer can demonstrate that de-energizing introduces additional hazards or increased risk.

Additional hazards or increased risk, such as….

interruption of life support equipment?

deactivation of emergency alarm systems?

shutdown of hazardous location ventilation equipment?

130.2(A) – Energized Work

(2) 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.

Infeasible due to equipment design or operational limitations, such as….

performing diagnostics and testing of electric circuits that can only be performed with the circuit energized?

and work on circuits that form an integral part of a continuous process?

Two Questions for any Live Work

Is it really *infeasible*?
Or was it just *inconvenient?*

Two Questions for any Live Work

Can you afford to work it Energized ?

130.2(B)(3) – EEWP Exceptions

(3) Exemptions to Work Permit. Work performed within the limited approach boundary of energized electrical conductors or circuit parts by qualified persons related to tasks such as testing, troubleshooting, and voltage measuring shall be permitted to be performed without an energized electrical work permit, if appropriate safe work practices and personal protective equipment in accordance with Chapter 1 are provided and used. If the purpose of crossing the limited approach boundary is only for visual inspection and the restricted approach boundary will not be crossed, then an energized electrical work permit shall not be required.

You must still perform elements 1-10!

130.1(B) - EEWP

See Annex J

(1) When Required. When working within the limited approach boundary or the arc flash boundary of exposed energized electrical conductors or circuit parts that are not placed in an electrically safe work condition [that is, for the reasons of increased or additional hazards or infeasibility per 130.2(A)], work to be performed shall be considered energized electrical work and shall be performed by written permit only.

CWI 250.38A, Sect 6.0

ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:

Job/Work Order Number

(1) Description of circuit/equipment/job location:

(2) Description of work to be done:

(3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

Requester/Title Date

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK:

Check when Complete

Electrically Qualified Person(s) Date

Electrically Qualified Person(s) Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

Manufacturing Manager Maintenance/Engineering Manager

Safety Manager Electrically Knowledgeable Person

General Manager Date

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

© 2004 National Fire Protection Association NFPA 70E (p. 1 of 1)

2012 Change

130.4(A) – Shock Hazard Analysis

(A) Shock Hazard Analysis. A shock hazard analysis shall determine the voltage to which personnel will be exposed, the boundary requirements, and the personal protective equipment necessary in order to minimize the possibility of electric shock to personnel.

Sounds complicated!

130.4(C) – Approach Boundaries

Unqualified

Overhead Lines

See OSHA Table S-5

(1) Nominal System Voltage Range, Phase to Phase	(2) [illegible]	(3) Exposed Fixed Circuit Part	(4)	(5) Prohibited Approach Boundary[1]
Less than 50	Not specified	Not specified	Not specified	Not specified
50 to 300	3.05 m (10 ft 0 in.)	1.07 m (3 ft 6 in.)	Avoid contact	Avoid contact
301 to 750	3.05 m (10 ft 0 in.)	1.07 m (3 ft 6 in.)	304.8 mm (1 ft 0 in.)	25.4 mm (0 ft 1 in.)
751 to 15 kV	3.05 m (10 ft 0 in.)	1.53 m (5 ft 0 in.)	660.4 mm (2 ft 2 in.)	177.8 mm (0 ft 7 in.)
15.1 kV to 36 kV	3.05 m (10 ft 0 in.)	1.83 m (6 ft 0 in.)	787.4 mm (2 ft 7 in.)	254 mm (0 ft 10 in.)
36.1 kV to 46 kV	3.05 m (10 ft 0 in.)	2.44 m (8 ft 0 in.)	838.2 mm (2 ft 9 in.)	431.8 mm (1 ft 5 in.)
46.1 kV to 72.5 kV	3.05 m (10 ft 0 in.)	2.44 m (8 ft 0 in.)	965.2 mm (3 ft 2 in.)	635 mm (2 ft 1 in.)
72.6 kV to 121 kV	3.25 m (10 ft 8 in.)	2.44 m (8 ft 0 in.)	991 mm (3 ft 3 in.)	812.8 mm (2 ft 8 in.)
138 kV to 145 kV	3.36 m (11 ft 0 in.)	3.05 m (10 ft 0 in.)	1.093 m (3 ft 7 in.)	939.8 mm (3 ft 1 in.)
161 kV to 169 kV	3.56 m (11 ft 8 in.)	3.56 m (11 ft 8 in.)	1.22 m (4 ft 0 in.)	1.07 m (3 ft 6 in.)
230 kV to 242 kV	3.97 m (13 ft 0 in.)	3.97 m (13 ft 0 in.)	1.6 m (5 ft 3 in.)	1.45 m (4 ft 9 in.)
345 kV to 362 kV	4.68 m (15 ft 4 in.)	4.68 m (15 ft 4 in.)	2.59 m (8 ft 6 in.)	2.44 m (8 ft 0 in.)
500 kV to 550 kV	5.8 m (19 ft 0 in.)	5.8 m (19 ft 0 in.)	3.43 m (11 ft 3 in.)	3.28 m (10 ft 9 in.)
765 kV to 800 kV	7.24 m (23 ft 9 in.)	7.24 m (23 ft 9 in.)	4.55 m (14 ft 11 in.)	4.4 m (14 ft 5 in.)

Note: For Flash Protection Boundary, see 130.3(A).

[1]See definition in Article 100 and text in 130.2(D)(2) and Annex C for elaboration.

Fact, Fiction or Fad?

We don't have to do a calculated flash hazard analysis, that's why there are PPE Tables in NFPA 70E

- ☐ Fact
- ☑ Fiction
- ☐ Fad

2012 Change

130.5 – Flash Hazard Analysis

130.5 Arc Flash Hazard Analysis. An arc flash hazard analysis shall determine the arc flash boundary, the incident energy at the working distance, and the personal protective equipment that people within the arc flash boundary shall use.

The arc flash hazard analysis shall be updated when a major modification or renovation takes place. It shall be reviewed periodically, not to exceed 5 years, to account for changes in the electrical distribution system that could affect the results of the arc flash hazard analysis.

The arc flash hazard analysis shall take into consideration the design of the overcurrent protective device and its opening time, including its condition of maintenance.

Sounds complicated!

130.5(C) – Equipment Labeling

Did your Flash Hazard Analysis?

(C) Equipment Labeling. Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units, and are likely to require examination, adjustment, servicing, or maintenance while energized, shall be field marked with a label containing all the following information:

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

(2) Nominal system voltage

(3) Arc flash boundary

130.5 – Flash Hazard Analysis

So, how is appropriate PPE for flash protection and the arc flash boundary determined if a Flash Hazard Analysis has not been completed?

2012 Change

130.7(C)(15(a) – Task Table

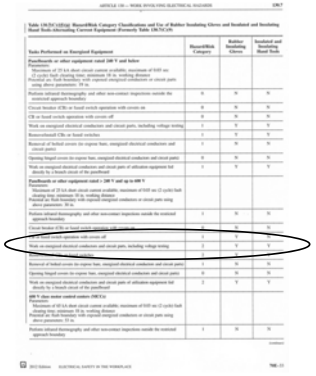


Table 130.7(C)(15)(a) Hazard/Risk Category Classifications and Use of Rubber Insulating Gloves and Insulated and Insulating Hand Tools Alternating Current Equipment (Formerly Table 130.7(C)(9)	Hazard/Risk Category	Rubber Insulating Gloves	Insulated and Insulating Hand Tools
Panelboards or other equipment rated 240 V and below			
Parameters: Maximum of 25 kA short circuit current available, maximum of 0.05 sec (3 cycles) fault clearing time, minimum 18 in. working distance. Flashes on flash boundary with exposed energized conductors or circuit parts using above parameters: 19 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	0	N	N
Circuit breaker (CB) or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	0	N	N
Work on energized electrical conductors and circuit parts, including voltage testing	1	Y	Y
Removal/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bus; energized electrical conductors and circuit parts)	1	N	N
Opening hinged covers (to expose bus; energized electrical conductors and circuit parts)	0	N	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	1	Y	Y
Panelboards or other equipment rated > 240 V and up to 600 V			
Parameters: Maximum of 25 kA short circuit current available, maximum of 0.05 sec (3 cycles) fault clearing time, minimum 18 in. working distance. Flashes on flash boundary with exposed energized conductors or circuit parts using above parameters: 30 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	1	N	N
Circuit breaker (CB) or fused switch operation with covers on	1	N	N
CB or fused switch operation with covers off	1	Y	Y
Work on energized electrical conductors and circuit parts, including voltage testing	1	Y	Y
Removal/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bus; energized electrical conductors and circuit parts)	1	N	N
Opening hinged covers (to expose bus; energized electrical conductors and circuit parts)	0	N	N
Work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panelboard	2	Y	Y
480 V class motor control centers (MCCs)			
Parameters: Maximum of 65 kA short circuit current available, maximum of 0.05 sec (3 cycles) fault clearing time, minimum 18 in. working distance. Flashes on flash boundary with exposed energized conductors or circuit parts using above parameters: 23 in.			
Perform infrared thermography and other non-contact inspections outside the restricted approach boundary	1	N	N

Hazard Risk Category Tables

EXTREMELY IMPORTANT! Don't forget the Notes!

These PPE requirements are based on specific fault currents and clearing times!

Do you know yours?

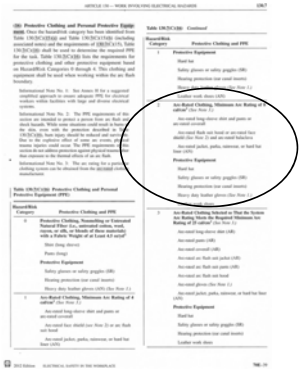
Hazard Risk Category Tables

EXTREMELY IMPORTANT! Don't forget the Notes!

But something is better than nothing at this point!

2012 Change

130.7(C)(16) – PPE Table



130.7(C)(16) – PPE Table

- **A face shield used in combination with a balaclava (sock hood) may be used instead of a hood where the incident energy does not exceed 12 cal/cm^2 (see 130.7(C)(10)).**

2012 Change

130.7(C)(16) – PPE Table

2 Cal	4-8 Cal	25 Cal	40 Cal
Hazard Risk Category 0	Hazard Risk Category 1/2	Hazard Risk Category 3	Hazard Risk Category 4

Fact, Fiction or Fad?

NFPA 70E…

- ☑ Fact
- ☐ Fiction
- ☐ Fad

Safe Travels &

Be safe out there !

©2011
Michael Kovacic (mkovacic@oshazone.com)

No job is so urgent
nor any action so vital
that we cannot take time
to perform our work safely

Today's Instructor

Michael Kovacic is a full-time Occupational Safety Instructor and Consultant.

Mr. Kovacic nearly 20 years of experience in the electrical safety industry. He has participated in or managed teams for safety audits for literally millions of square feet of facility, representing over 150 heavy industrial facilities for major corporations and government organizations. Mr. Kovacic is involved in the development of several computer database applications which aid in the record keeping and reporting portions of the assessment function. He has participated in flash hazard analysis for numerous facilities as well, and has background in accident investigation and legal assistance.

Mr. Kovacic has an extensive knowledge of various standards, including DOD/DOE requirements and Army, Navy and Air Force safety programs, which has allowed him to successfully conduct various standard and customized courses on the OSHA Standards, the National Electrical Code, and NFPA 70E for the U.S. Department of Labor at the OSHA Training Institute in Chicago, IL., various State OSHA Departments, Federal Aviation Administration (FAA), the American Society of Safety Engineers (ASSE), Bureau of Worker's Compensation (Ohio) and numerous major private corporations such as Aluminum Company of America (Alcoa) and Heinz, and is a specialist in NFPA 70E, including flash hazard and safety-related work practices.

Additionally, this expertise in electrical safety and knowledge of standards has allowed for coauthoring and rewriting of complete electrical safety programs for major corporations and government entities around the country.

Due to his expertise and years of experience, Michael Kovacic also provides expert witness testimony both in pre-trail deposition and in court.

His unique experience in engineering, manufacturing, installation, and occupational safety allows him to relate extremely well to students from many different backgrounds.

mkovacic@oshazone.com

In the time it takes you to listen to this presentation,
there will be two
***preventable* electrical-related workplace accidents**