

P-15

Electrical Safety

I. Policy

This operating procedure provides the basic requirements for Electrical Safety for Qualified Persons working at facilities controlled and operated by the PA Department of General Services (DGS).

The Department policy is that only Qualified Persons will work on electrical equipment and installations. Work will be done on de-energized equipment whenever possible. If work must be done on energized equipment, Qualified Persons must use appropriate procedures, equipment and personnel protective equipment as described in this program and in the referenced documents. Unqualified Persons shall not be exposed to energized equipment.

II. References

The following documents are referred to in this procedure. The documents provide important information that is integral for the implementation of this procedure. It is not the intention of this procedure to restate all of the requirements of the referenced documents. It is also not the intent of this program to provide guidance on the methods of electrical wiring installations or connections. It is assumed that use of this program is by a qualified electrician with knowledge of the requirements of the National Electrical Code (NEC). The requirements of the referenced documents are adopted by reference herein.

- A. *OSHA 29 CFR 1910 Subpart S Electrical*
- B. *NFPA 70E- Standard For Electrical Safety in the Workplace*
- C. *NFPA 70 National Electrical Code (NEC)*
- D. *Department of General Services Lockout/Tag-out Program*

III. Responsibilities

- A. Supervisors shall ensure that employees who may work on energized systems are trained as Qualified Persons and have the proper safety equipment and personal protective equipment to do the required operations safely.
- B. Supervisors shall ensure their personnel are familiar with these procedures and adhere to its guidelines.
- C. Supervisors are responsible for the implementation of this program and for the annual inspection of all related equipment.
- D. Employees are responsible to know the hazards of electrical systems, understand the requirements of this program, and use the safety equipment and personal protective as required.
- E. The Safety Coordinator, Bureau Directors, and Consultant are available to provide guidance and the Bureau Directors are responsible for ensuring the implementation of this procedure throughout DGS.

IV. General Safety Requirements

A. Batteries and Battery Rooms

1. Restricted Access

Battery room access should be restricted to authorized personnel. The room should be kept locked unless occupied.

There should be no foreign piping or other equipment in the room that would require access by other personnel.

The battery rooms should not be used for storage.

2. Ventilation Requirements

Ventilation in the rooms should be sufficient to prevent liberated hydrogen gas from exceeding a concentration of 1 percent (10,000 ppm). Refer to NFPA 70E Section 320.4(C) for design requirements of the ventilation systems.

3. Personal Protective Equipment

The following personal protective equipment shall be available to employees performing battery maintenance:

- Goggles and face shield
- Chemical resistant gloves
- Protective aprons
- Protective overshoes or boots
- Portable or stationary eyewash facilities

4. Tools and Equipment

Tools and equipment for working on batteries should be non-sparking and voltage rated for the maximum working voltage.

B. High Voltage Electrical Rooms and Enclosures (More than 600 volts)

1. Restricted Access

Doors to high voltage electrical rooms must be kept locked at all times and access must be restricted to qualified and authorized personnel.

2. Enclosure Construction

Outdoor installations shall be enclosed with a fence that is 7 feet high or 6 feet high with three strands of barbed wire on top. Access to the fenced enclosure shall be controlled by a lock and key. For voltages of 601 to 13,799 volts, the minimum distance to live parts is 10 feet. For voltages up to 230,000, the minimum distance to live parts is 15 feet.

In indoor installations, all high voltage equipment shall be enclosed in metal cabinets inside locked fire-resistant rooms. The rooms shall have a minimum fire rating of 3 hours.

3. Separation from Low-Voltage Equipment

Where low voltage equipment such as switches, cutouts, or lighting panels are in rooms where there are exposed high voltage parts, the low voltage parts must be separated by a panel, fence or screen.

4. Warning Signs

Where voltages exceed 600 volts, equipment or rooms must be posted with permanent and conspicuous warning signs with the following language:

“DANGER---HIGH VOLTAGE---KEEP OUT”

C. Tools and Equipment

1. All tools, equipment and personal protective equipment must be must be voltage rated and provide protection for the voltages worked on. This includes all electrical test equipment.
2. All tools, equipment and personal protective equipment must be visually inspected before each use and at a minimum at least annually.
3. All tools, equipment and personal protective equipment must be electrically tested at least every three years.
4. Discard any equipment that is visually damaged, blistered, cracked, discolored, or fails the electrical testing.

V. Procedures

A. De-Energizing Electrical Systems

When possible, electrical parts must be de-energized and placed in an electrically safe work condition. The parts must be locked out according to the DGS Lockout/Tag-out program for low voltage equipment and by following equipment specific switching orders for high voltage equipment. The Qualified Person must verify the system is de-energized by voltage testing before beginning work on the part or equipment.

B. Hazard/Risk Evaluation

Before any work is started on or near live parts operating at 50 volts or more, or where an electrical hazard exists, the Supervisor or Foreman shall conduct a hazard/risk evaluation.

The hazard risk evaluation shall include a review of:

- Voltage of the equipment that will be worked on
- Potential for arc flash and/or electric shock
- Availability of appropriate protective equipment and clothing
- The knowledge and understanding of the hazards by the Qualified Persons

C. Pre-Job Briefing

Before starting each job, the Supervisor or Foreman shall conduct a job briefing that will include a discussion of:

- Hazards of the job or operation
- Work procedures
- Special precautions
- Energy source controls
- A review of whether energized equipment can be or is properly locked out
- Personal protective equipment

D. Selection of PPE (See Appendix B and Appendix C)

Table 130.7(C)(9)(a) in Appendix B is organized by Task and Hazard Category. The Hazard Category then defines the specific PPE that is required for the task in Table 130.(C)(10) in Appendix C. These tables can be used if a flash hazard analysis is not conducted by a Qualified Person. Sections E, F, and G below present some typical situations and the selection of appropriate tools and PPE. Refer to NFPA 70E for more details or for other specific situations. As the hazard increases, the requirements for more fire and flash resistant clothing go up.

E. Working on Energized Panel boards (240 volts and below, including voltage testing)

1. Operating circuit breakers or fused switch operation with covers on or covers off:
 - Hazard Category 0
 - No voltage rated gloves or tools needed
 - Long sleeve shirts and long pants required
 - Safety glasses required
2. Working on energized parts, including voltage testing, removing or installing circuit breakers:
 - Hazard Category 1
 - Voltage rated tools and gloves required
 - Fire rated shirt and blue jeans or fire rated pants required, or use fire rated coveralls.
 - Hard hat and safety glasses required

F. Working on Energized Panel boards or Switchboards (>240 volts up to 600 volts)

1. Operating circuit breakers or fused switch operation with covers on
 - Hazard Category 0
 - No voltage rated gloves or tools needed
 - Long sleeve shirts and long pants required
 - Safety glasses required
2. Operating circuit breakers or fused switch operation with covers off:
 - Hazard Category 1
 - Voltage rated tools and gloves not required
 - Fire rated shirt and blue jeans or fire rated pants required, or use fire rated coveralls.
 - Hard hat and safety glasses required
3. Working on energized parts, including voltage testing
 - Hazard Category 2
 - Voltage rated tools and gloves required
 - T shirt, pants, fire rates coveralls required
 - Safety glasses or goggles required
 - Arc rated face shield or flash suit hood required
 - Ear plugs are required



- Leather gloves over the voltage rated gloves are required
- Leather work shoes are required
- Energized work permit required

G. Working on Equipment over 600 volts

1. Hazard Categories of 2, 3 and 4 are present depending on operation. (See Table 130.7(C)(9)(a) in Appendix B)

- Voltage rated tools and gloves required
- Fire resistant clothing required
- Hard hat, safety glasses or goggles, ear protection, leather gloves, leather shoes required
- Fire resistant hard hat liners required with Hazard Category 3 and 4
- Flash suit hood required with Hazard Category 3.
- Full multi-layer flash suit required with Hazard Category 4.

2. Permit System

All work on energized high voltage parts or equipment must be completed using an Energized Work Permit and authorized by a High Voltage Electrical Supervisor.

3. Switching Orders

All switching of high voltage electrical systems must be done according to specific Switching Orders developed by a High Voltage Electrical Supervisor. The switching orders will include step by step instructions for de-energizing, grounding, testing, and re-energizing equipment. The switching orders will include PPE requirements, two man policy, and notification requirements and permit requirements. All Switching Orders shall be retained in a file and shall be reviewed before each operation. The Supervisor shall audit the performance of the Switching Orders and shall review the procedures with Qualified Employees at least annually. The Switching Orders shall be reviewed and updated as necessary and at least annually.

4. Only Qualified Persons who are specifically trained in High Voltage Electrical Safety may do work on systems with over 600 volts energized parts. These employees must have and been trained in the specific work practices and PPE required for high voltage work. The employees must have the appropriate PPE and practice the use of the PPE before working on energized systems

V. Training

A. Qualified Persons

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 special precautionary techniques, personal protective equipment, 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 considered unqualified for others. Such persons permitted to work within limited approach of exposed energized conductors and circuit parts shall, at a minimum, be additionally trained in all of the following:

- (a) The skills and techniques necessary to distinguish exposed energized parts from other parts of electric equipment
- (b) The skills and techniques necessary to determine the nominal voltage of exposed energized parts
- (c) The approach distances and the corresponding voltages to which the qualified person will be exposed
- (d) The 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
- (e) Periodicity of training is dependent on the level of hazard.

B. Unqualified Persons

Unqualified persons shall be trained in and be familiar with any of the electrical safety-related practices that might not be addressed specifically by Part II, but are necessary for their safety.

Appendix A

Definitions

Definitions (From NFPA 70E)

De-energized – Free from any electrical connection to a source of potential difference and from electrical charge; not having a potential different from that of earth.

Electrical Hazard – A dangerous condition such that contact or equipment failure can result in electric shock, arc flash, burn, thermal burn, or blast.

Electrically Safe Work Condition – A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged according to the DGS Lockout/Tag-out Program, tested to ensure the absence of voltage, and grounded if determined necessary.

Enclosed – Surrounded by a case, housing, fence or wall(s) that prevent persons from accidentally contacting energized parts.

Energized – Electrically connected to or having a source of voltage over 50 volts.

Exposed (as applied to live parts) – Capable of being inadvertently touched or approached nearer than a safe distance by a person. This applies to parts that are not suitably guarded, isolated or insulated.

Flame-Resistant (FR) – The property of clothing or protective equipment that prevents, terminates or inhibits combustion. For FR clothing, there are degrees of protection. See Appendix D.

Flash Protection Boundary – An approach limit at a distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur.

Flash Suit – A complete FR clothing and equipment system that includes pants, jacket, and hood with face shield.

High Voltage Electrical Work – Work on systems that may have nominal voltages exceeding 600 volts.

Limited Approach Boundary – An approach limit at a distance from an exposed live part within which a shock hazard exists.

Prohibited Approach Boundary – An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part.

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 on the hazards involved.



Appendix B Hazard/Risk Category Classifications NFPA 70E Table 130.7(C)(9)(a)

ARTICLE 130 — WORKING ON OR NEAR LIVE PARTS

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(9) Selection of Personal Protective Equipment.

(a) When Required for Various Tasks. 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. The assumed short-circuit current capacities and fault clearing times for various tasks are listed in the text and notes to Table 130.7(C)(9)(a). For tasks not listed, or for power systems with greater than the assumed short-circuit current capacity or with longer than the assumed fault clearing times, a flash hazard analysis shall be required in accordance with 130.3.

FPN No. 1: Both larger and smaller available short-circuit currents could result in higher available arc-flash energies. If the available short-circuit current increases without a decrease in the opening time of the overcurrent protective device, the arc-flash energy will increase. If the available short-circuit current decreases, resulting in a longer opening time for the overcurrent protective device, arc-flash energies could also increase.

FPN No. 2: Energized parts that operate at less than 50 volts are not required to be de-energized to satisfy an "electrically safe work condition." Consideration should be given to the capacity of the source, any overcurrent protection between the energy source and the worker, and whether the work task related to the source operating at less than 50 volts increases exposure to electrical burns or to explosion from an electric arc.

Table 130.7(C)(9)(a) Hazard/Risk Category Classifications

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	Hazard/ Risk Category	V-rated Gloves	V-rated Tools
Panelboards Rated 240 V and Below — Notes 1 and 3			
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 parts, including voltage testing	1	Y	Y
Remove/install CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bare, energized parts)	1	N	N
Opening hinged covers (to expose bare, energized parts)	0	N	N
Panelboards or Switchboards Rated >240 V and up to 600 V (with molded case or insulated case circuit breakers) — Notes 1 and 3			
CB or fused switch operation with covers on	0	N	N
CB or fused switch operation with covers off	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
600 V Class Motor Control Centers (MCCs) — Notes 2 (except as indicated) and 3			
CB or fused switch or starter operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch or starter operation with enclosure doors open	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120 V, exposed	2*	Y	Y
Insertion or removal of individual starter "buckets" from MCC — Note 4	3	Y	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N

Table 130.7(C)(9)(a) *Continued*

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	Hazard/ Risk Category	V-rated Gloves	V-rated Tools
600 V Class Switchgear (with power circuit breakers or fused switches) — Notes 5 and 6			
CB or fused switch operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120 V, exposed	2*	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open	3	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	2*	Y	N
Removal of bolted covers (to expose bare, energized parts)	3	N	N
Opening hinged covers (to expose bare, energized parts)	2	N	N
Other 600 V Class (277 V through 600 V, nominal) Equipment — Note 3			
Lighting or small power transformers (600 V, maximum)	—	—	—
Removal of bolted covers (to expose bare, energized parts)	2*	N	N
Opening hinged covers (to expose bare, energized parts)	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N
Revenue meters (kW-hour, at primary voltage and current)	—	—	—
Insertion or removal	2*	Y	N
Cable trough or tray cover removal or installation	1	N	N
Miscellaneous equipment cover removal or installation	1	N	N
Work on energized parts, including voltage testing	2*	Y	Y
Application of safety grounds, after voltage test	2*	Y	N
NEMA E2 (fused contactor) Motor Starters, 2.3 kV Through 7.2 kV			
Contactors operation with enclosure doors closed	0	N	N
Reading a panel meter while operating a meter switch	0	N	N
Contactors operation with enclosure doors open	2*	N	N
Work on energized parts, including voltage testing	3	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	0	Y	Y
Work on control circuits with energized parts >120 V, exposed	3	Y	Y
Insertion or removal (racking) of starters from cubicles, doors open	3	N	N
Insertion or removal (racking) of starters from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	3	Y	N
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N

Table 130.7(C)(9)(a) *Continued*

Task (Assumes Equipment Is Energized, and Work Is Done Within the Flash Protection Boundary)	Hazard/ Risk Category	V-rated Gloves	V-rated Tools
Metal Clad Switchgear, 1 kV and Above			
CB or fused switch operation with enclosure doors closed	2	N	N
Reading a panel meter while operating a meter switch	0	N	N
CB or fused switch operation with enclosure doors open	4	N	N
Work on energized parts, including voltage testing	4	Y	Y
Work on control circuits with energized parts 120 V or below, exposed	2	Y	Y
Work on control circuits with energized parts >120 V, exposed	4	Y	Y
Insertion or removal (racking) of CBs from cubicles, doors open	4	N	N
Insertion or removal (racking) of CBs from cubicles, doors closed	2	N	N
Application of safety grounds, after voltage test	4	Y	N
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Opening voltage transformer or control power transformer compartments	4	N	N
Other Equipment 1 kV and Above			
Metal clad load interrupter switches, fused or unfused	—	—	—
Switch operator, doors closed	2	N	N
Work on energized parts, including voltage testing	4	Y	Y
Removal of bolted covers (to expose bare, energized parts)	4	N	N
Opening hinged covers (to expose bare, energized parts)	3	N	N
Outdoor disconnect switch operation (hookstick operated)	3	Y	Y
Outdoor disconnect switch operation (gang-operated, from grade)	2	N	N
Insulated cable examination, in manhole or other confined space	4	Y	N
Insulated cable examination, in open area	2	Y	N

Note:

V-rated Gloves are gloves rated and tested for the maximum line-to-line voltage upon which work will be done.

V-rated Tools are tools rated and tested for the maximum line-to-line voltage upon which work will be done. 2* means that a double-layer switching hood and hearing protection are required for this task in addition to the other Hazard/Risk Category 2 requirements of Table 130.7(C)(10).

Y = yes (required)

N = no (not required)

Notes:

- 25 kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
- 65 kA short circuit current available, 0.03 second (2 cycle) fault clearing time.
- For < 10 kA short circuit current available, the hazard/risk category required may be reduced by one number.
- 65 kA short circuit current available, 0.33 second (20 cycle) fault clearing time.
- 65 kA short circuit current available, up to 1.0 second (60 cycle) fault clearing time.
- For < 25 kA short circuit current available, the hazard/risk category required may be reduced by one number.

Appendix C

Protective Clothing and PPE Matrix

NFPA 70E Table 130.7(C)(10)

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Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Matrix

Protective Clothing and Equipment	Protective Systems for Hazard/Risk Category						
	Hazard/Risk Category Number	-1 (Note 3)	0	1	2	3	4
Non-melting (according to ASTM F 1566-00) or Untreated Natural Fiber							
a. T-shirt (short-sleeve)	X				X	X	X
b. Shirt (long-sleeve)		X				X	X
c. Pants (long)	X	X	X (Note 4)	X (Note 6)		X	X
FR Clothing (Note 1)							
a. Long-sleeve shirt			X	X		X (Note 9)	X
b. Pants			X (Note 4)	X (Note 6)	X (Note 9)	X (Note 9)	X
c. Coverall			X (Note 5)	X (Note 7)	X (Note 9)	X (Note 9)	X (Note 5)
d. Jacket, parka, or rainwear			AN	AN	AN	AN	
FR Protective Equipment							
a. Flash suit jacket (multilayer)							X
b. Flash suit pants (multilayer)							X
c. Head protection							
1. Hard hat			X	X	X	X	X
2. FR hard hat liner						AR	AR
d. Eye protection							
1. Safety glasses	X	X	X	AL	AL	AL	AL
2. Safety goggles				AL	AL	AL	AL
e. Face and head area protection							
1. Arc-rated face shield, or flash suit hood				X (Note 8)			
2. Flash suit hood					X	X	X
3. Hearing protection (ear canal inserts)				X (Note 8)	X	X	X
f. Hand protection							
Leather gloves (Note 2)			AN	X	X	X	X
g. Foot protection							
Leather work shoes			AN	X	X	X	X

AN = As needed
AL = Select one in group
AR = As required
X = Minimum required

Notes:

1. See Table 130.7(C)(11). Arc rating for a garment is expressed in cal/cm².
2. If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy this requirement.
3. Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Table 130.7(C)(9)(a).
4. Regular weight (minimum: 12 oz/yd² fabric weight), untreated, denim cotton blue jeans are acceptable in lieu of FR pants. The FR pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.
5. Alternate is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants.
6. If the FR pants have a minimum arc rating of 8, long pants of non-melting or untreated natural fiber are not required beneath the FR pants.
7. Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or untreated natural fiber pants and T-shirt.
8. A faceshield with a minimum arc rating of 8, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or, alternatively, a flash suit hood), is required.
9. Alternate is to use two sets of FR coveralls (the inner with a minimum arc rating of 4 and outer coverall with a minimum arc rating of 5) over non-melting or untreated natural fiber clothing, instead of FR coveralls over FR shirt and FR pants over non-melting or untreated natural fiber clothing.

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Appendix D

Protective Clothing Characteristics

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Table 130.7(C)(11) Protective Clothing Characteristics

Hazard/Risk Category	Typical Protective Clothing Systems	
	Clothing Description (Typical number of clothing layers is given in parentheses)	Required Minimum Arc Rating of PPE [J/cm ² (cal/cm ²)]
0	Non-melting, flammable materials (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a fabric weight at least 4.5 oz/yd ² (1)	N/A
1	FR shirt and FR pants or FR coverall (1)	16.74 (4)
2	Cotton underwear — conventional short sleeve and brief/shorts, plus FR shirt and FR pants (1 or 2)	33.47 (8)
3	Cotton underwear plus FR shirt and FR pants plus FR coverall, or cotton underwear plus two FR coveralls (2 or 3)	104.6 (25)
4	Cotton underwear plus FR shirt and FR pants plus multilayer flash suit (3 or more)	167.36 (40)

Note: Arc rating is defined in Article 100 and can be either ATPV or E_{BT}. ATPV is defined in ASTM F 1959-99 as the incident energy on a fabric or material that results in sufficient heat transfer through the fabric or material to cause the onset of a second-degree burn based on the Stoll curve. E_{BT} is defined in ASTM F 1959-99 as the average of the five highest incident energy exposure values below the Stoll curve where the specimens do not exhibit breakerpen. E_{BT} is reported when ATPV cannot be measured due to FR fabric breakerpen.

(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 the rubber gloves.

FPN: Insulating rubber gloves and gloves made from layers of flame-resistant material provide hand protection against the arc flash hazard. Heavy-duty leather (e.g., greater than 12 oz/yd²) gloves provide protection suitable up to Hazard/Risk Category 2. The leather protectors worn over insulating rubber gloves provide additional arc flash protection for the hands. During high arc flash exposures leather can shrink and cause a decrease in protection.

(d) Foot Protection. Heavy-duty leather work shoes provide some arc flash protection to the feet and shall be used in all tasks in Hazard/Risk Category 2 and higher.

(14) Clothing Material Characteristics FR clothing shall meet the requirements described in 130.7(C)(14)(a) through 130.7(C)(15).

FPN: FR materials, such as flame-retardant treated cotton, meta-aramid, para-aramid, and poly-benzimidazole (PBI) fibers, provide thermal protection. These materials can ignite but will not continue to burn after the ignition source is removed. FR fabrics can reduce burn injuries during an arc flash exposure by providing a thermal barrier between the arc flash and the wearer. In aramid and PBI blends, para-aramid adds strength to a fabric to prevent the fabric from breaking open due to the blast shock wave and high thermal energy of the arc.

(a) Melting. Clothing made from flammable synthetic materials that melt at temperatures below 315°C (600°F), such as acetate, nylon, polyester, polypropylene, and spandex, either alone or in blends, shall not be used.

FPN: These materials melt as a result of arc flash exposure conditions, form intimate contact with the skin, and aggravate the burn injury.

Exception: Fiber blends that contain materials that melt, such as acetate, nylon, polyester, polypropylene, and spandex, shall be permitted if such blends in fabrics meet the requirements of ASTM F 1506, Standard Performance Specification for Textile Material for Wearing Apparel for Use by Electrical Workers Exposed to Momentary Electric Arc and Related Thermal Hazards, and if such blends in fabrics do not exhibit evidence of a melting and sticking hazard during arc testing according to ASTM F 1959 [see also 130.7(C)(15)].

(b) Flammability. Clothing made from nonmelting flammable natural materials, such as cotton, wool, rayon, or silk, shall be permitted for Hazard/Risk Categories 0 and -1 considered acceptable if it is determined by flash hazard analysis that the exposure level is 8.36 J/cm² (2.0 cal/cm²) or less, and that the fabric will not ignite and continue to burn under the arc exposure hazard conditions to which it will be exposed (using data from tests done in accordance with ASTM F 1958.) See also 130.7(C)(12)(a) for layering requirements.

FPN No. 1: Non-FR cotton, polyester-cotton blends, nylon, nylon-cotton blends, silk, rayon, and wool fabrics are flammable. These fabrics could ignite and continue to burn on the body, resulting in serious burn injuries.

FPN No. 2: Rayon is a cellulose-based (wood pulp) synthetic fiber that is a flammable but nonmelting material.

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Appendix D
Appendix
X E

Sample Energized Electrical work Permit

ANNEX J

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Annex J Energized Electrical Work Permit

This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.
J.1 Figure J.1 illustrates considerations for an Energized Electrical Work Permit.

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
(1) Detailed job description procedure to be used in performing the above detailed work: _____	<input type="checkbox"/>
(2) Description of the Safe Work Practices to be employed: _____	<input type="checkbox"/>
(3) Results of the Shock Hazard Analysis: _____	<input type="checkbox"/>
(4) Determination of Shock Protection Boundaries: _____	<input type="checkbox"/>
(5) Results of the Flash Hazard Analysis: _____	<input type="checkbox"/>
(6) Determination of the Flash Protection Boundary: _____	<input type="checkbox"/>
(7) Necessary personal protective equipment to safely perform the assigned task: _____	<input type="checkbox"/>
(8) Means employed to restrict the access of unqualified persons from the work area: _____	<input type="checkbox"/>
(9) Evidence of completion of a Job Briefing including discussion of any job-related hazards: _____	<input type="checkbox"/>
(10) Do you agree the above described work can be done safely? <input type="checkbox"/> Yes <input type="checkbox"/> No (If no, return to requester)	

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.

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Figure J.1 Sample Permit for Energized Electrical Work.

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