

A Far Better 70E

NFPA 70E-2004 has the most protective PPE requirements in the world. If heeded, they probably will eliminate most electrical fatalities in the workplace.

by Hugh Hoagland, Bill Shinn, and Victoria Reed



Article from:

<http://www.stevenspublishing.com/Stevens/OHSPub.nsf/frame?open&redirect=http://www.stevenspublishing.com/stevens/OHSPub.nsf/PubHome/7961EDDA13AB147E86256EE100686103?Opendocument>

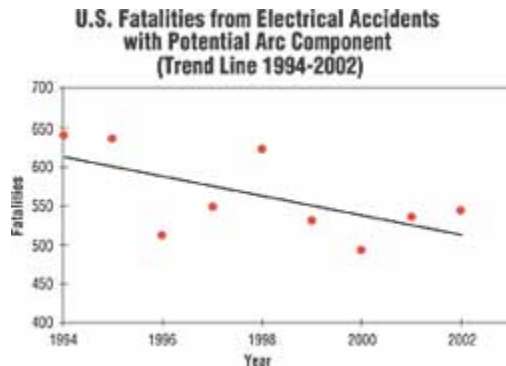
NFPA 70E-2004, published in April of this year, is the new "how you work on it" standard in electrical safety. With the coupling of NFPA 70E's work practice standard and the "how you build it" approach of the NFPA 70 National Electric Code's (NEC) construction standard, industry now has a more complete picture of how to protect employees who are exposed to shock and arc hazards.

The birth of the 70E standard as a "how you work on it" maintenance standard to complement the NEC's "how you build it" approach was fostered by a request from the Occupational Safety and Health Administration. OSHA recognized safe work practices guidelines were missing from the NEC, and statistics indicated there was a need for such guidelines. Some of the most compelling statistics reviewed by NFPA in its research leading up to the standard were based on U.S. industry studies and BLS data. The findings included:

- An average of 4,000 non-disabling and 3,600 disabling electrical contact injuries in the workplace occur annually in the United States.
- One person is fatally electrocuted in the workplace every day.
- Electrocutions were the fourth leading cause of traumatic occupational fatalities.

- More than 2,000 workers are sent to burn centers each year with electrical burns.
- The National Electric Code had an original mission of preventing fire ignition in buildings, to assist in cost containment for insurance companies. The first years of 70E attempted the same mission by helping workers prevent fire ignition in their maintenance procedures. However, in the face of the above statistics, the standard quickly took on the goal of preventing electrocution. This change of philosophy was taken a step further when the standard first introduced the idea of electric arc flash PPE.

The concept of workers exposed to electrical hazards protecting themselves with arc- and flame-resistant clothing was first put into an OSHA standard in 1994. OSHA's 1910.269 became known as the apparel standard. It stated that clothing could not increase the extent of injuries resulting from electrical accidents. The apparel standard spurred the development of arc-resistant materials and clothing lines for workers exposed to electrical arc hazards. The adoption of this standard across all industries probably has influenced the positive trend in arc-related fatalities during the 10 years since its inception (Figure 1).



Improvements in the 2004 Standard

NFPA 70E takes the concept of clothing protective issues one step farther by being the first standard to specifically include arc flash PPE in work practice requirements. The 70E standard met with a lukewarm reception when first published in 2000. There were problems with NFPA 70E-2000 because of difficulties with the way the standard was written. Some new concepts lacked explanation, presenting a stiff learning curve for anyone unfamiliar with arc flash terms and issues. The standard was also written in a way that made it difficult to find the information you needed when you needed it. The average electrician would have to wade through 50 pages of engineering installation, wiring, and special use instructions before getting to the work practice section; much important information was relegated to footnotes.

The new NFPA 70E-2004 edition resolves many of the issues. The full reorganization of the standard makes it easier to use and understand. The 70E committee took on the task of making the standard more understandable for the average electrician who needed the information to perform his/her job safely.

The organization of the new standard puts the most-used safety practices, including the clothing requirements, in the first section--right after the definitions. The previous standard spent the first half on NEC-related installation material and special equipment, which relegated the PPE and

hazard assessment requirements to the second half. This caused many electricians to stop reading before they reached the newest and most applicable material.

The layout of the new standard is:

- Chapter 1: Safety-related work practices
- Chapter 2: Safety-related maintenance requirements
- Chapter 3: Safety requirements for special equipment
- Chapter 4: NEC-related installation material

The new standard follows the 70E-2000 version's "no tolerance policy" on electric shock/contact and predicted second-degree burn in arc flash exposures. Embedded in NFPA 70E-2004 are the following strategies to accomplish this goal:

- Creation of an electrically safe work condition by a preference toward de-energizing equipment when feasible.
- Training for *all* workers exposed to potential arc flash or electrical shock hazards. This includes operators who may be "task qualified" to operate a disconnect, electrically unqualified workers, and office personnel. All are required to be trained in the basics of electrical safety to prevent unqualified persons from entering live work and arc flash zones.
- Creation of arc flash boundaries to complement the approach boundaries for shock hazards.
- Management must now justify and approve through a new energized work permit requirement all energized maintenance and repair work except testing, troubleshooting, etc. This makes live work "non-routine."
- PPE requirements in the standard are the most protective in the world. If heeded, they will reduce the severity of accidents and probably eliminate most electrical fatalities in the workplace.

The standard simplifies the decision-making process regarding what to wear in most electrical hazard working situations. Levels of protection as defined by the standard correlate to specific clothing recommendations but offer flexibility because NFPA requires standards to avoid design restriction to allow innovation in protection, donning, doffing, fit, *and* worker comfort. The hazard/risk category is defined by two methods: a *table method* that gives a category for each work task, and a *calculation method* that allows for direct prediction of the energy levels the worker is exposed to in a given situation. The calculation method, though more involved, allows for reduction or elimination of some PPE by engineering out the hazard.

Other Changes, Cautions

Predicted exposures greater than 40 cal/cm² are not addressed by the standard. If a company's hazard assessment indicates energy levels above this level, there is no guidance from 70E; members of the committee have indicated they are uncomfortable with PPE used to protect in these exposures. A recent calculation of arc blast levels indicates that at high amperages such as 65kA with an arc exposure of 65 cal/cm², the arc blast nears 30 PSI, which is sufficient to cause worker trauma from the pressure wave.

Use PPE suits only for designed exposures over 40 cal/cm² with engineering guidance. Keep in mind that working on energized equipment and circuits with high short circuit current and greater than 40 cal/cm² exposure could be like "smoking in a dynamite shed."

Following are a few other changes NFPA 70E-2004 has from the 2000 version:

- An arc rated 8 cal/cm² faceshield is now required for all Hazard/Risk Category 2 tasks. (Table 130.7(C)(10), footnote 8)
- Hazard/Risk Category 1 is reduced from 5 cal/cm² to 4 cal/cm².
- Working in the Prohibited Approach Boundary is considered touching the energized part.
- Qualified Person is now required to receive "safety training on the hazards involved."
- Article 110.4 on "Multiemployer Relationship" requires the Owner and Contractor to inform each other of existing hazards, PPE required, safe work procedures, and emergency procedures applicable to the work involved.
- For HRC 2 tasks not requiring shock protection, the standard now recommends that a heavy-duty leather (>12 oz/yd²) glove be worn. A good-quality, all-leather work glove would meet this requirement. Our testing has shown leather to be quite protective.

Hazard/Risk Category	Common Clothing	Common Tasks¹
0 Up to 1.2 cal/cm ² exposure	100% cotton shirt and denim jean or 100% cotton uniform pant	Operation of Circuit Breaker with panel covers on or off up to 240V. Reading a panel meter while operating a meter switch on switchgear >1000V
1 1.3 to 4 cal/cm ² exposure	4.5 oz. Nomex, 4.5 oz. Nomex Rayon, 5.5 oz. UltraSoft, and FR pant or denim jean >12 oz/yd ²	Voltage testing or live installation of a circuit breaker in a panelboard up to 240V. Operation of Circuit Breaker with panel covers off up to 600V.
2 4.1 to 8 cal/cm ² exposure	7 oz. UltraSoft, other FR shirts with mandatory T-shirts, >9 oz. FR pant usually UltraSoft or FR cotton denim jean	Insertion or removal (racking) of circuit breakers in 600V Class Switchgear with doors open or closed. Operation of Circuit Breakers in 1000V and above switchgear with doors closed. Insertion or removal (racking) of CBs from cubicles doors closed on 100V switchgear.
2* 4.1 to 8 cal/cm ² exposure with face exposure potential	Same as above but with Paulson faceshield with chin cup, MSA faceshield with chin cup, Salisbury faceshield with chin cup, or Oberon faceshield with sideshields and chin cup. Some use a balaclava hood, and the 70E standard always has allowed a full	Work on control circuits with energized parts >120 V exposed in 600V Class MCCs. Work on energized parts, including voltage testing in 600V Class MCCs.

	flash hood for these exposures. The new 2004 standard allows the full face protection to be a faceshield with good side protection and chin protection. Some add shields, and some shields meet this requirement by their design and adding a chin cup.	
3 8.1 to 25 cal/cm ² exposure	Coverall over FR uniform and flash hood to >25 cal/cm ² . Oberon 31 cal/cm ² Flash Suit	Insertion or removal of individual starter "buckets" from 600V Class MCC.
4 25.1 to 40 cal/cm ² exposure	Steelgrip 40 cal/cm ² , Salisbury 40 cal/cm ² , NSA 65 cal/cm ² , Oberon 50 cal/cm ² , Chicago Protective 45 cal/cm ² , Stanco 40 cal/cm ² , Spedmill 40 cal/cm ² , American Safety 40 cal/cm ² . All of these flash suits must meet ASTM F1506 for the materials and ASTM F2178 for the hood/facepiece.	Work on energized parts, including voltage testing in switchgear >1000V.
<i>Some of these examples have specific current and clearing time requirements in the table that your system might not meet, and they would then require a full hazard assessment.</i>		

New Products Coming Along

NFPA 70E requires winterwear and rainwear also to be arc resistant, and all apparel worn to meet the following ASTM standards when exposed to electric arc:

- Clothing: ASTM F1506
- Rainwear: ASTM F1891
- Hoods and faceshields: ASTM F2178

Many companies are responding to the needs created by this standard and the raised awareness of electric arc hazards. For example, fall protection now has a new arc test method in ASTM F887-2004. Bashlin, Buckingham, and Miller now have harnesses tested to meet this standard and others, including Web-rite, MSA, Klein Tools, DBI/Sala, Protecta, Ultrasafe, and French Creek, are working on them.

A new, very interesting product is now available from Web-rite. Their fall protection harness meets ASTM F887-2004 and the webbing is actually dielectric and oil resistant. The new polyurethane coating has been developed by BioPlastics, Inc. (www.bioplastics.us) and is currently used in the petroleum industry to keep fall protection harnesses clean, but the dielectric properties are similar to rubber gloves in wet testing, helping to eliminate tracking of electricity in wet weather conditions.

Voltage rated gloves, long in use by utilities, now have information on arc rating. W.H. Salisbury & Company tested its most popular gloves for ignition probability and arc protection; the report is available on www.arcwear.com. The good news is that Black Class 2 gloves have only a 10 percent probability of ignition at 99 cal/cm², and leather protectors and plain, clean leather gloves provide good arc protection up to about 40 cal/cm².

OSHA's 1910.269 apparel standard, promulgated in 1994, has been helping to reduce the severity of workers' electrical injuries and injuries in electric arc flashes by prevent clothing ignitions in utilities. Now, NFPA 70E is helping to reduce the same injuries for all electricians and has raised the bar of protection for workers around the world. Its international implementation by leaders such as Alcoa, GM, Ford, and many others has made their workers safer in electrical arc exposures.

The standard's adaptation for utility use and acceptance by electricians the world over will continue to influence the downward trend of fatalities and serious injuries from electric arc incidents.

Hugh Hoagland is a consultant who can be reached at hugh@ArcWear.com. Bill Shinn, P.E., is a hazard assessment training consultant with ArcWear.com and can be reached at wkshinn@yahoo.com. Victoria Reed is a freelance writer and business owner.