

Arc-Flash Hazards – Standards and Regulations

The following arc-flash hazard industry standards are intended to increase employees' protection from dangers associated with the release of energy caused by an electrical arc. These standards and regulations are key elements of an effective arc-flash safety program⁴.

NFPA 70 National Electrical Code 2008

Flash protection – product safety signs, personal protective equipment and clothing

110.16 Flash Protection:

“Electrical equipment, such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.”

Fine Print Note No. 1:

“NFPA 70E-2004, *Standard for Electrical Safety in the Workplace*, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.”

Fine Print Note No. 2:

“ANSI Z535.4-1998, *Product Safety Signs and Labels*, provides guidelines for the design of safety signs and labels for application to products.”

[Note: Fine Print Notes (FPNs) are not requirements of the NEC and are not enforceable.]

From NEC 2008 Handbook²:

“Exhibit 110.7, shows an electrical employee working inside the flash protection boundary and in front of a large-capacity service-type switchboard that has not been de-energized and that is not under the lockout/tagout procedure. The worker is wearing personal protective equipment (PPE) considered appropriate flash protection clothing for the flash hazard involved. Suitable PPE appropriate to a particular hazard is described in NFPA 70E, *Standard for Electrical Safety In the Workplace*.”



Exhibit 110.7 Electrical worker clothed in personal protective equipment (PPE) appropriate for the hazard involved.²

Institute of Electrical and Electronics Engineers (IEEE) Standard

Arc-Flash hazard calculations

From IEEE Standard 1584-2002 (*IEEE Guide for Performing Arc-Flash Hazard Calculations*) and IEEE Standard 1584a-2004, Amendment 1:

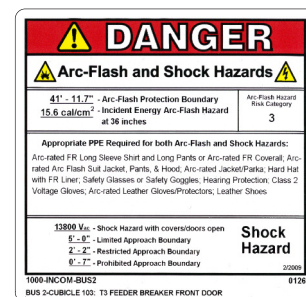
This standard provides the necessary equations and methods to calculate the expected arc-flash protection boundary and the incident energy to which workers could be exposed while working on or near exposed energized electrical equipment.

From NFPA 70E³ Standard for Electrical Safety in the Workplace 2009 Edition:

130.3(B) Protective Clothing and Other Personal Protective Equipment (PPE) for Application with an Arc Flash Hazard Analysis.

“Where it has been determined that work will be performed within the Arc Flash Protection Boundary identified by 130.3(A), one of the following methods shall be used for the selection of protective clothing and other personal protective equipment:

- 1) Incident Energy Analysis
- 2) Hazard/Risk Categories



Example of a GE Arc-Flash and Shock Hazards equipment label.



From NFPA 70E 2009 Edition:

TABLE 130.7(C)(11) Protective Clothing Characteristics

Hazard/Risk Category	Clothing Description	Required Min 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	NA
1	Arc-rated FR shirt and FR pants or FR coverall	16.74 (4)
2	Arc-rated FR shirt and FR pants or FR coverall	33.47 (8)
3	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	104.6 (25)
4	Arc-rated FR shirt and pants or FR coverall, and arc flash suit selected so that the system arc rating meets the required minimum	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, *Standard Test Method for Determining the Arc Thermal Performance Value of Materials for Clothing*, as the incident energy on a material or a multilayer system of materials that results in a 50% probability that sufficient heat transfer through the tested specimen is predicted to cause the onset of a second-degree skin burn injury based on the Stoll curve, cal/cm². E_{BT} is defined in ASTM F 1959 as the incident energy on a material or material system that results in a 50% probability of breakopen. Arc rating is reported as either ATPV or E_{BT}, whichever is the lower value.

Occupational Safety and Health Administration (OSHA) Regulations

Workplace safety requirements

OSHA does not specifically address arc-flash hazards but does recognize hazards (through the General Duty Clause) that are identified by other industry codes and standards such as the NEC and NFPA 70E.

OSHA 29 CFR 1910.269(l)(6)(iii):

“The employer shall ensure that each employee who is exposed to the hazards of flames or electric arcs does not wear clothing that, when exposed to flames or electric arcs, could increase the extent of injury that would be sustained by the employee.”

OSHA 1910.132(d)(1):

“The employer shall assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the employer shall:

1910.132(d)(1)(i): Select, and have each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment;

1910.132(d)(1)(ii): Communicate selection decisions to each affected employee; and,

1910.132(d)(1)(iii): Select PPE that properly fits each affected employee. Note: Non-mandatory Appendix B contains an example of procedures that would comply with the requirement for a hazard assessment.

OSHA Supports NFPA Standards:

In response to an inquiry about OSHA's stand on arc-flash hazard, Richard S. Terrill, the Regional Administrator for Occupational Safety and Health, US Department of Labor for the Northwest Region at Seattle, concluded as follows:

“Though OSHA does not, per se, enforce the NFPA standard, 2009 Edition, OSHA considers NFPA standard a recognized industry practice. The employer is required to conduct assessment in accordance with CFR 1910.132(d)(1). If an arc-flash hazard is present, or likely to be present, then the employer must select and require employees to use the protective apparel. Employers who conduct the hazard/risk assessment, and select and require their employees to use protective clothing and other PPE appropriate for the task, as stated in the NFPA 70E standard, 2009 Edition, are deemed in compliance with the Hazard Assessment and Equipment Selection OSHA standard.”

For more information, contact your local GE Energy office or call 1-888-GE4-Serv or 540-378-3280 or see the Arc-Flash Hazard Study Fact Sheet (GEA-13752E)



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⁴ GE makes no representation that the quoted standards constitute an exclusive list of guidance or standards potentially applicable to customer equipment or Arc-Flash hazards.

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