


ARC-FLASH HAZARDS & PERSONAL PROTECTIVE EQUIPMENT

 WARNING	
Arc Flash and Shock Hazard Appropriate PPE Required	
32 inch	Flash Hazard Boundary
2.77	cal/cm² Flash Hazard at 18 inches
Class 1	FR Shirt & Pants
480 VAC	Shock Hazard when cover is removed
00	Glove Class
42 inch	Limited Approach
12 inch	Restricted Approach
1 inch	Prohibited Approach
Bus: SERVICE4	

The proper selection and use of Personal Protective Equipment (PPE) will significantly reduce the risk of arc-flash and other electrical hazards to personnel working on energized equipment. Except for three conditions, OSHA (1910.333(a)(1)) and NFPA 70E 2004 (130.1) require equipment be deenergized before any work is performed. The three exceptions are performing diagnostic tests such as checking for voltage and current, if deenergizing the equipment would create a greater hazard, or if the system voltage is below 50 volts. The use of PPE will not prevent all injuries, but it will help minimize injury from arc-flash hazards. NFPA and IEEE methods of selecting PPE vary, but are highly dependant on the task to be performed. This document concentrates on methods for selecting PPE outlined by NFPA 70E 2004. It is meant to serve as a guide only in helping select proper PPE.

NFPA 70E 2004 provides two methods for selection of PPE. One method presents common work tasks in a table format along with the respective Hazard/Risk Category for each task. The PPE is then selected based on the Hazard/Risk Category. The other method requires a Flash Hazard Analysis which provides a more detailed look at the individual task and electrical system. PPE is then selected based on the incident energy level calculated during the Flash Hazard Analysis.

It is important to note that the level of PPE that is recommended by NFPA 70E is “intended to protect a person from arc-flash and shock hazards”. Even with PPE, some arc-flash conditions may result in burns to the skin or include arc blast pressures, toxic vapors, and propelled particles and materials. These factors must be considered when selecting PPE.

Common Personal Protective Equipment Terms

Incident Energy – measurement of thermal energy at a specified distance from the arc (normally 18 inches). Incident Energy is typically measured in cal/cm².

Arc Thermal Performance Exposure Value (ATPV) – the incident energy level (in cal/cm²) that would cause the onset of a second-degree burn as defined by ASTM P S58 Standard.

V-rated – tools and gloves rated and tested for the line-to-line voltage at the area where the work is to be performed.

Flame Resistant or Flame Retardant (FR) – a term referring to fabric and its ability to limit the severity of burning.

Breakopen Threshold Energy (E_{BT}) – the highest incident energy level which did not cause flame resistant (FR) fabric breakopen and does not exceed second-degree burn criteria.

The Selection of PPE per NFPA 70E 2004 Edition

Utilizing NFPA 70E Table 130.7(C)(9)(a)

1. Determine common work task from NFPA 70E Table 130.7(c)(9)(a) *Hazard Risk Category Classifications* that matches work to be performed.
2. Identify Hazard/Risk Category of task (0-4)
3. Refer to NFPA 70E Table 130.7 (c)(10) *Protective Clothing and Personal Protective Equipment Matrix* to determine all required PPE for the Hazard/Risk Category of the task.
4. Read all applicable “Notes” that may apply

Note: NFPA 70E Tables make many assumptions with regards to the available short-circuit current and fault clearing times. Tasks that do not appear in the tables or exceed assumptions are required to have a Flash Hazard Analysis performed in accordance with NFPA 70E 130.3. Caution must also be used when determining the level of PPE, and all applicable NFPA table notes and options must be considered.

Performing a Flash Hazard Analysis

1. Determine the arcing fault current
2. Determine the minimum body approach distance (typically 18”)
3. Determine arc duration (based on clearing time of overcurrent protective device)
4. Calculate the incident energy (cal/cm²) at the minimum approach distance
5. Determine the Flash Protection Boundary (curable burn distance) – Refer to NFPA 70E, Annex D
6. Select appropriate PPE based on the incident energy level (cal/cm²).
7. Label equipment warning of arc-flash hazards to comply with NEC 110.16

Personal Protective Equipment Cautions

- Use only PPE with ratings equal to or higher than the incident energy level (cal/cm²)
- Always properly clean and launder PPE prior to use (per manufacturer’s specifications)
- Inspect PPE and make necessary repairs to the manufacturer’s specifications prior to use
- Replace PPE after expected wear life
- Avoid fabric contamination from oils and other flammable materials (example: mosquito repellent containing “DEET”).
- It is recommended that PPE should not be used once it has been exposed to an arc condition. If it is to be reused, it must be inspected, cleaned, and repaired to manufacturer’s specifications.



This document is only a guide for selection of PPE utilizing NFPA 70E. NFPA 70E 2004 also includes the calculation model from IEEE 1584 “Guide for Performing Arc-Flash Hazard Calculations”. To optimize safety to personnel and minimize risk to potential electrical hazards, OSHA and NFPA recommendations must always be followed. For more information, refer to NFPA 70E 2004 Edition.