



Unified Facilities Criteria (UFC) 3-560-02, Electrical Safety

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UFC 3-560-02, Electrical Safety

- ◆ Purpose – provide safety requirements for electrical workers
- ◆ Lead agency – Navy
 - Point of contact – John Peltz
- ◆ Current status – draft

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UFC 3-560-02
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UNIFIED FACILITIES CRITERIA (UFC)

ELECTRICAL SAFETY

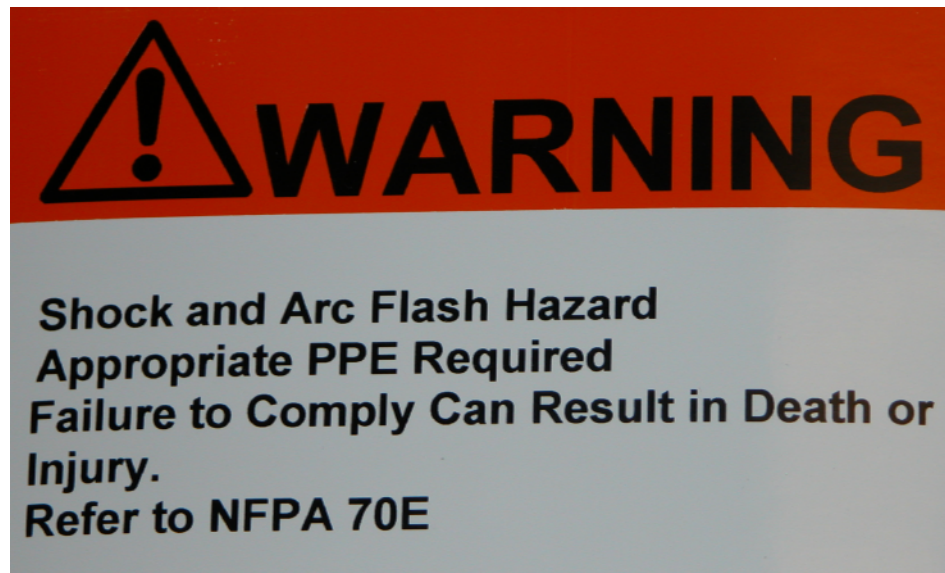


Contacts

- ◆ Navy – John Peltz
- ◆ Air Force – Dr. Daryl Hammond
- ◆ Army – Robert Billmyre

Significant Changes

- ◆ Energized work addressed in detail
- ◆ Personal protective equipment (PPE) requirements clarified
- ◆ Arc flash protection included



Arcing Fault Events

- ◆ An arc is produced by flow of electrical current through ionized air after an initial flashover or short circuit
- ◆ Arcs produce some of the highest temperatures known to occur on earth – up to 35,000 deg F. This is four times the surface temperature of the sun
- ◆ All known materials are vaporized at this temperature











Arc Flash Effects

- ◆ Average of 1710 (*reported*) electrical burns per year in USA
 - Burn from intense heat
 - Trauma from blast pressure
 - Toxic gases from vaporized metal
 - Sprayed molten metal droplets
 - Hearing damage from sound pressure wave
 - Eye damage



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Basis for Requirements

Electrical Safety Requirements – OSHA CFR Title 29

- ◆ Part 1910 Occupational Safety and Health Standard, Subpart S – Electrical
 - Design Safety Standards and Safety Related Work Practices
- ◆ Part 1926 Safety and Health Regulations for Construction, Subpart K – Electrical
 - Installation Safety Requirements, Safety Related Work Practices, Safety Related Maintenance Practices

Electrical Safety Requirements – OSHA CFR Title 29

- ◆ Part 1910 is for general industry
- ◆ Part 1926 is for the construction industry
- ◆ OSHA standards tend to provide general requirements and often do not provide specific details

OSHA's General Duty Clause

- ◆ “each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious harm to employees.”

NFPA 70E-2004

- ◆ *Standard for Electrical Safety in the Workplace*
- ◆ Provides the specific guidance not provided in OSHA documents
- ◆ Was developed to assist OSHA in the area of electrical safety
- ◆ Uses same or similar wording as OSHA and NFPA 70, *National Electrical Code* (NEC) in several sections

Energized Line Work

- ◆ NFPA 70E, Article 130.1:
 - “Live parts to which an employee might be exposed shall be put into an electrically safe work condition before an employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards, or is infeasible due to equipment design or operational limitations.”

NFPA 70E-2004

- ◆ Significant changes and reorganized
- ◆ Arc flash and PPE requirements addressed in detail
- ◆ References IEEE 1584, *IEEE Guide for Performing Arc-Flash Hazard Calculations*



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New or Expanded Requirements

UFC 3-560-02 – Major Changes

- ◆ Clearly adopts NFPA 70E as a basis for electrical safety
- ◆ Expands requirements related with working on energized electrical equipment
- ◆ Addresses PPE requirements for protection from the burn effects of arcing faults

Energized Work Permit

- ◆ Description of work and location
- ◆ Justification for why the work must be performed in an energized condition
- ◆ Description of work practices to be followed
- ◆ An electrical shock analysis and boundaries (safe working distance)

Energized Work Permit

- ◆ Arc flash hazard analysis and flash boundary determination
- ◆ Necessary PPE to safely perform the task
- ◆ Means to restrict access of unqualified persons in work area
- ◆ Evidence of completing the job briefing, i.e. safety, tools, PPE, any other hazards

Personal Protective Equipment

- ◆ PPE requirements will include:
 - FR shirt and pants (or FR coveralls) with minimum arc rating of 8 cal/cm²
 - Safety glasses (no metal frames) with side shields
 - Leather electrical hazard-rated (EH) work shoes
 - Leather gloves
 - Voltage-rated gloves with leather protectors

Personal Protective Equipment

- ◆ PPE requirements will include:
 - Arc flash hood in combination with a face shield rated for a minimum of 8 cal/cm² attached to a hard hat, or an arc flash protective hood rated for a minimum of 8 cal/cm²
 - Hearing protection as required in accordance with local procedures

Flame Resistant (FR) Clothing

Hazard/Risk Category	General Clothing Description	Required Minimum PPE Arc Rating (cal/cm ²)
0	Non-melting, flammable materials	N/A
1	Flame-resistant (FR) shirt and FR pants, or FR coverall over Category 0 clothing	4
2	Category 1 clothing, including cotton underwear (conventional short sleeve t-shirt and brief/shorts)	8
3	Category 2 clothing with an extra set of coveralls (FR shirt and pants with cotton underwear plus FR coverall, or cotton underwear plus two FR coveralls)	25
4	FR shirt and pants with cotton underwear plus multilayer flash suit	40



Arc Flash Hood

Arc Flash Protective Hoods
10 - 20 cal/cm²



AFHOOD15

AFHOOD10



AFHOOD20



Arc Flash Protective Hood



Arc Flash Hazard Analysis

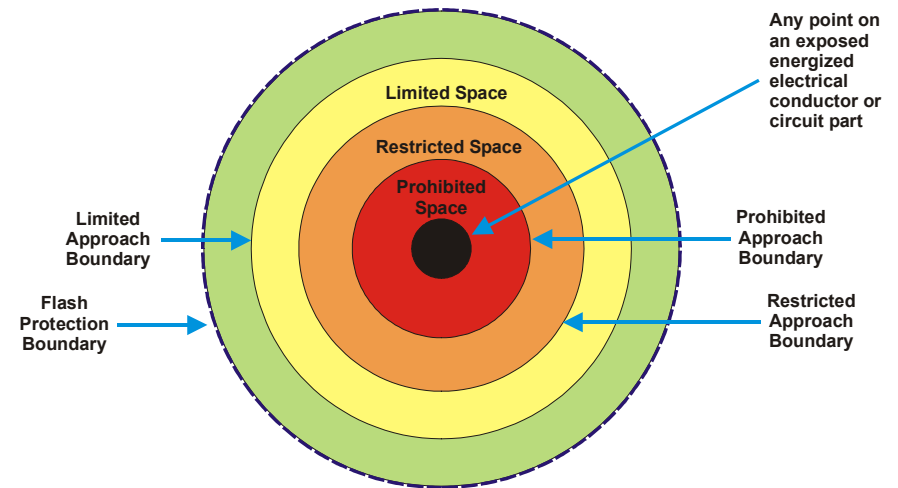
- ◆ Determines flash protection boundary and PPE requirements as a function of location and work activity
- ◆ Typically requires electrical analysis software to do an effective arc flash hazard analysis
- ◆ UFC will provide tables for various tasks if the arc flash hazard analysis tools are not available

Arc Flash Hazard Analysis

- ◆ Arc flash hazard and flash protection boundary varies with:
 - Type of equipment and equipment configuration
 - Available short circuit current
 - Voltage
 - Predicted fault duration – protective devices upstream of the arcing fault and their settings

Approach Boundaries

- ◆ Limited Approach
- ◆ Restricted Approach
- ◆ Prohibited Approach



- ◆ All of these are based solely on voltage
- ◆ Flash protection boundary is different

Typical Arc Flash PPE Criteria

- ◆ Operating low voltage breakers with covers on – standard FR clothing
- ◆ Working on 480 volt exposed energized parts – FR clothing, arc flash hood, hard hat with face shield, voltage-rated gloves with leather protectors
- ◆ Racking switchgear in and out – above gear plus FR coveralls

Typical Arc Flash PPE Criteria

- ◆ Working between the secondary side of a distribution transformer and the service disconnect – above gear plus FR coveralls
- ◆ Work on energized high voltage parts – multilayer flash suit
- ◆ Exterior high voltage hot stick work – FR clothing, arc flash hood, hard hat with face shield, voltage-rated gloves with leather protectors