

Attachment 5 - PPE Requirements and Other Protective Equipment for Electrical Work

A. Acceptable Work Clothing

Employees and contractors engaged in electrical work on systems operating at or above 250 volts, or when working within the arc flash boundary (including opening and closing of circuit breakers), must not wear clothing made from flammable synthetic materials or materials that melt. Some examples of prohibited clothing are polyester, nylon, synthetic-cotton blends, acetate, polypropylene, and spandex.

B. Personal Protective Equipment (PPE) Requirements

Employees working in areas where electrical hazards are present or may be present, or on exposed parts of electrical equipment that cannot be de-energized, shall be provided with and shall use personal protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

Employees working within the arc flash protective boundary and/or limited approach boundary of operating equipment shall wear AR protective clothing and insulating PPE in accordance with the Hazard/Risk Category Classification provided by the arc flash hazard analysis. If an arc flash analysis has not been completed for a particular task or equipment, then the Hazard/Risk Category Classification contained in NFPA 70E Table 130.7(C)(15)(a) shall be followed (see table below describing requirements for each hazard/risk category).

Work within the arc flash boundary shall not be permitted when the calculated incident energy at the working distance exceeds 40 cal/cm².

Arc-rated apparel shall be inspected before each use. Work clothing or arc flash suits that are contaminated, or damaged to the extent that their protective qualities are impaired, shall not be used. Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used.

Arc-rated apparel shall be stored in a manner that prevents physical damage; damage from moisture, dust, or other deteriorating agents; or contamination from flammable or combustible materials.

When arc rated clothing is cleaned, manufacturer's instructions shall be followed to avoid loss of protection..

Insulating (shock protective equipment) PPE shall be specifically rated for the level of voltages that will be encountered.

Insulating PPE and equipment shall be selected to meet the criteria established by the American Society of Testing and Materials (ASTM) Standards and by the American National Standards Institute (ANSI). Safety shoes must be electrical hazard (EH) rated.

PPE requirements shall be established in the EEW Permit.

B-1 NFPA 70E Table 130.7(C)(16) Protective Clothing and Personal Protective Equipment (PPE) Matrix

Hazard/Risk Category	Protective Clothing and PPE
0	<p>Protective Clothing, Nonmelting or Untreated Natural Fiber (i.e., untreated cotton, wool, rayon, or silk, or blends of these materials) with a Fabric Weight of at Least 4.5 oz/yd²</p> <p>Shirt (long sleeve) Pants (long)</p> <p>Protective Equipment</p> <p>Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (AN) (<i>See Note 1.</i>)</p>
1	<p>Arc-Rated Clothing, Minimum Arc Rating of 4 cal/cm² (<i>See Note 3.</i>)</p> <p>Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated face shield (<i>see Note 2</i>) or arc flash suit hood Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective Equipment</p> <p>Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (<i>See Note 1.</i>) Leather work shoes (AN)</p>
2	<p>Arc-Rated Clothing, Minimum Arc Rating of 8 cal/cm² (<i>See Note 3.</i>)</p> <p>Arc-rated long-sleeve shirt and pants or arc-rated coverall Arc-rated flash suit hood or arc-rated face shield (<i>See Note 2</i>) and arc-rated balaclava Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p> <p>Protective Equipment</p> <p>Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Heavy duty leather gloves (<i>See Note 1.</i>) Leather work shoes</p>
3	<p>Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 25 cal/cm² (<i>See Note 3.</i>)</p> <p>Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves (<i>See Note 1.</i>) Arc-rated jacket, parka, rainwear, or hard hat liner (AN)</p>

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Hazard/Risk Category	Protective Clothing and PPE
3	Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather work shoes
4	Arc-Rated Clothing Selected so That the System Arc Rating Meets the Required Minimum Arc Rating of 40 cal/cm² (See Note 3.) Arc-rated long-sleeve shirt (AR) Arc-rated pants (AR) Arc-rated coverall (AR) Arc-rated arc flash suit jacket (AR) Arc-rated arc flash suit pants (AR) Arc-rated arc flash suit hood Arc-rated gloves (<i>See Note 1.</i>) Arc-rated jacket, parka, rainwear, or hard hat liner (AN) Protective Equipment Hard hat Safety glasses or safety goggles (SR) Hearing protection (ear canal inserts) Leather work shoes

AN: as needed (optional). AR: as required. SR: selection required.

Notes:

(1) If rubber insulating gloves with leather protectors are required by Table 130.7(C)(15)(a), additional leather or arc-rated gloves are not required. The combination of rubber insulating gloves with leather protectors satisfies the arc flash protection requirement.

(2) Face shields are to have wrap-around guarding to protect not only the face but also the forehead, ears, and neck, or, alternatively, an arc-rated arc flash suit hood is required to be worn.

(3) *Arc rating* is defined in Article 100 and can be either the arc thermal performance value (ATPV) or energy of break open threshold (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 percent 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, in 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 percent probability of breakopen. Arc rating is reported as either ATPV or E_{BT}, whichever is the lower value.

C. Inspection and Testing of Insulating PPE and Equipment

PPE and insulating equipment shall be maintained in a safe, reliable condition and shall be inspected before each use following the requirements listed:

- Visual inspections shall consist of examining for holes, tears, punctures, cuts, ozone cracking (a series of interlacing cracks that look like the rubber is old), embedded foreign objects, textural defects such as swelling, softening, hardening, or stickiness, and any other defect which degrades the insulating quality.
- Before each use, insulating gloves shall be given an air test along with a visual inspection. Leather protective gloves shall be worn over insulating gloves at all times with the leather glove extending at least 1 inch beyond the wrist. The insulating glove shall extend at least 1 inch beyond the leather glove.
- If any defects are observed, the PPE or insulating equipment shall be discarded and replaced.

Insulating PPE and equipment shall be tested per the prescribed schedule below. The equipment shall be marked with the date last tested.

From OSHA 1910.137 Table 1-6	
Type of Equipment	Electrical Testing Frequency
Rubber Insulating Gloves	Before first issue and every 6 months thereafter
Rubber Insulating Blankets	Before first issue and every 12 months thereafter
Rubber Insulating Sleeves	Before first issue and every 12 months thereafter

D. Electrically Insulated and Voltage Rated Tools

- Employees and contractors shall use insulated tools and/or handling equipment when working inside the limited approach boundary of exposed energized conductors and circuit parts where tools or handling equipment might make accidental contact with live conductors or cross the prohibited approach boundary.
- The electrical tools and protective equipment must be specifically approved, rated, and tested for the levels of voltage of which an employee may be exposed.
- Fuse handling equipment (insulated for circuit voltage) must be used to remove or install fuses when the fuse terminals are energized. Ropes and hand lines used near exposed energized parts must be non-conductive.
- Protective shields, barriers or insulating materials must be used to protect each employee from shock, burns, or other electrical injuries while that person is working near exposed energized parts that might be accidentally contacted or where dangerous electric heating or arcing might occur.

E. Table of Electrical Protective Equipment that meet ASTM standards for Electrical Protective Equipment

Protective Equipment or Apparel	ASTM Standard Number
Rubber insulating gloves	D120
Rubber matting for use around electric apparatus	D178
Rubber insulating blankets	D1048
Rubber insulating covers	D1049
Rubber insulating line hose	D1050
Rubber insulating sleeves	D1051
In-Service Care of Insulating Line Hose & Covers	F478
In-Service Care of Insulating Gloves and Sleeves	F479
Leather protectors for rubber insulating gloves and mittens	F696
Fiberglass reinforced plastic rod and tube used in live line tools	F711
Test methods for electrical insulation plastic guards equipment for protection of workers	F712
Definitions of terms relation to electrical protective equipment	F819
Temporary grounding systems to be used on de-energized electric power lines and equipment	F855
Test method for determining dielectric strength of overshoe footwear	F1116
Dielectric overshoe footwear	F1117
Guide for visual inspection of electrical protective rubber.	F1236