Electrical Safety PPE Best Practices including 1910.269 OSHA Safety Review for Outside Line Electrical Utility

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Arc Flash & Shock Hazard PPE
Affected Employees and Employers?

• Do you work on 50 Volts or Greater?
• Do you use a Multi-meter?
• Anyone coming in contact with 50V +……Wear your gloves! Know the arc flash hazard exposure!

If Your Answer is Yes -
To Even One Of These- It Applies
OSHA 1910.269 – Relates to work on or near electric power generation, transmission, and distribution lines and equipment and the electrical hazards they present.

OSHA 1926.960 – Qualified Employees may work on or with energized lines or parts of equipment....50 VAC + ...includes safeguards for personal protection. (a) use of protective equipment. (1) Personal protective equipment.
Electrical Safety Standards for Employee Workplaces

This standard suggests how to determine and calculate electrical hazards in the workplace. Within this standard are recommendations for proper PPE (Personal Protective Equipment).

Hazards:
- Shock
- Arc Flash
- Blast
OSHA 1910.269 & 1926.960 UPDATES

- Arc Flash Hazard Analysis is required
  - Arc flash protection programs required
  - Arc flash clothing required
  - New calculated Minimum Approach
  - Distances required
  - Fall Protection required
OSHA Subpart V

- **Who is Affected?**
  - Electrical utilities, coops and municipalities

- **Training**
  - **Qualified Workers**
    - The degree of training must be determined by risk to the worker for the hazard involved.
    - Qualified workers must have training to recognize and control or avoid electrical hazards present at the worksite.
  - **Tree Trimmers**
    - Line-clearance tree trimmers must have training to identify exposed live parts and to determine the voltage on those parts.
    - They must have training in minimum approach distances so they are sure to maintain them.
OSHA Subpart V

- Training Required 1x every 3 years
- QUALIFIED WORKERS
  - Electrical contractors that cover both CI and UT markets, & municipalities, CI electrical workers
  - Personnel who are required to examine, adjust, troubleshoot or test energized equipment
  - Personnel who service, or maintain electrical equipment while it is energized and meet the standards required for qualified personnel as defined by NFPA 70E.
- Online refresher courses available
OSHA Subpart V

• **Contractors**
  • Host and contract employers must share safety-related matters and practices.
  • Host and contract employees must coordinate their work rules and procedures.

• **Fall Protection**
  • April 1, 2015, qualified workers must use fall protection when climbing or changing location on poles, towers, or similar structures unless climbing or changing location with fall protection is infeasible or creates a greater hazard than climbing or changing location without it.
  • Arc Rating: Fall arrest equipment must be capable of passing a drop test after exposure to an electric arc with a heat energy of 40±5 cal/cm².
  • April 1, 2015, work-positioning equipment must be rigged so that workers can free fall no more than 0.6 meters, or 2 feet.
OSHA Subpart V

- Minimum Approach Distances and Insulation
  - Minimum approach distance revisions were effective April 1, 2015. OSHA provides a minimum approach distance calculator on its website and in the standard.

- Protection from Flames and Electric Arc Hazards
  - The employer must assess the workplace to identify workers exposed to flame or electric arc hazards.
  - January 1, 2015, employers must estimate the incident heat energy of any electric arc hazard to which a worker would be exposed.
  - April 1, 2015, employers generally must provide workers exposed to hazards from electric arcs with protective clothing and other protective equipment with an arc rating greater than or equal to the estimated heat energy.
FR and Arc Rated Clothing
• FR clothing is defined as clothing that does not melt, ignite, or contribute to the injury of the wearer.
• Arc rated clothing is required whenever the calculated energy is greater than 2.0 cal/cm².
• Arc rated clothing must cover the entire body with exception for hands, feet, and head protection
  • Example: wearing a coat, cloak alone without pants or a bib is unacceptable

Face Shields
• The protection for the employee's head may consist of head protection meeting OSHA 1926.100(b)(2) and a face shield with a minimum arc rating of 8 cal/cm if the estimated incident energy exposure is less than 13 cal/cm² for exposures involving single-phase arcs in open air or 9 cal/cm² for other exposures,

• Exposures involving single phase arcs in open air, the arc rating for the employee's head and face protection may be 4 cal/cm² less than the estimated incident energy.
FR VS ARC RATED CLOTHING ILLUSTRATION
Who is affected? Meter Service Workers, Substation, Underground, Troubleshooters, or Contractors

- 2.0 calories and above, arc flash clothing is required
What does an arc flash suit look like, “I don’t want to wear a moon-suit!”

More comfortable, lighter weight fabrics that perform to better protect a worker from the intense heat in an arc flash...
Better air flow and visibility with lift front hoods, air circulating hoods, task lights

Confirm:
Arc flash suits are clearly labeled with an ATPV value
Label identifies the garment meets ASTM F1506 (Material Performance Test) & ASTM F1959 (Arc Rating Determination Test) Standards

Options:
Coats/Pants
Coats/Bibs
Shirt/Pants
*May include a combination of the above options depending on the arc rating required.
Insulating Gloves & Arc Flash Testing

ATPV Value is not Required for Gloves.

Test data shows that gloves have a very high ATPV value by themselves up to 25 cal/cm²; when combined with a protector, it is an equal or a higher ATPV value system.

Damaged or soiled PPE, PPE stained with petroleum based chemicals, including gloves, protectors, sleeves or arc flash clothing will ignite. Take care of your PPE. Keep it clean or replace when required.
GLOVES & SLEEVES AFTER ARC FLASH INCIDENT
FACE SHIELDS OSHA 1910.269 & 1926.960

**What?** Face Shields – 10, 12 & 20 Cal Universal & Full Brim Styles, 40 cal Lift Front Hood

**Who?** Meter Service Workers, Linemen, Substation, Trouble Shooters, Underground, Electrical Contractors, Municipalities
# Face Shields OSHA REVISIONS – APPENDIX E

- Minimum Head and Face Protection

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Minimum head and face protection</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None*</td>
</tr>
<tr>
<td></td>
<td>Arc-rated faceshield with a minimum rating of 8 cal/cm²*</td>
</tr>
<tr>
<td></td>
<td>Arc-rated hood or faceshield with balaclava</td>
</tr>
<tr>
<td>Single-phase, open air ..........</td>
<td>2-8 cal/cm²</td>
</tr>
<tr>
<td>Three-phase</td>
<td>2-4 cal/cm²</td>
</tr>
<tr>
<td></td>
<td>9-12 cal/cm²</td>
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<tr>
<td></td>
<td>5-8 cal/cm²</td>
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<tr>
<td></td>
<td>13 cal/cm² or higher†.</td>
</tr>
<tr>
<td></td>
<td>9 cal/cm² or higher‡.</td>
</tr>
</tbody>
</table>

*These ranges assume that employees are wearing hardhats meeting the specifications in §1910.135 or §1926.100(b)(2), as applicable.
†The arc rating must be a minimum of 4 cal/cm² less than the estimated incident energy. Note that §1926.960(g)(5)(v) permits this type of head and face protection, with a minimum arc rating of 4 cal/cm² less than the estimated incident energy, at any incident energy level.
‡Note that §1926.960(g)(5) permits this type of head and face protection at any incident energy level.

- Faceshield is not required when the calculated exposure is less than 9 cal/cm² for single phase exposures in air or less than 5cal/cm² for multiphase exposures.
FACE SHIELD OSHA 1910.269 & 1926.960

More comfortable, better air flow with lift front hoods and air circulating hoods, better visibility with a larger window shield, improved color recognition, anti-fog features and capability to add task lights

Confirm:
Face shields are clearly marked with an ATPV Label, and identifies the shield meets ASTM F2178 (performance & arc rating determination test) Standards

Options:
Weight Balancing Face Shields
Lift Front Hoods
Air Circulating Hoods
FOOTWEAR OSHA 1910.269 & 1926.960

Foot Protection

• In addition to revising the Electric Power Generation, Transmission, and Distribution, and the Electrical Protective Equipment standards, OSHA also revised the General Industry Foot Protection standard to clarify that an employer must ensure that workers use protective footwear as a supplementary form of protection when the use of protective footwear will protect the workers from electrical hazards, such as static-discharge or electric-shock hazards, that remain after the employer takes other necessary protective measures.

• OSHA Guideline Summary
OSHA letters of interpretation present EH shoes positively but do not require them. In higher voltages or higher risks (1910.269), **OSHA cites ASTM F1117 for dielectric shoes** – not ASTM F2413 for EH shoes.
Touch and Step Potentials

- **Touch Potential**
  - Protect With:
    - **EPZ bonding mats or insulated matting**
      - The worker is only protected if they remain on the mat.
    - **Rated di-electric overshoes**
      - Eliminates current path of hand-body-foot, and allows mobility.
    - **Rubber Gloves**
      - Insulates hands from current path of hand-body-feet.
    - **Barricade area, structure, equipment, etc.**
      - Prevents workers or public from entering the hazard area.
Touch and Step Potentials

- **Step Potential**
  - Protect with
    - **EPZ bonding mats or insulated matting**
      - The worker is only protected if they remain on the mat.
    - **Rated dielectric overshoes**
      - Eliminates current path of foot-body-foot or hand-body-foot, and allows mobility.
  - **Barricade area, structure, equipment, etc.**
    - Prevents workers or public from entering the hazard area.
  - **Keep temporary ground rods out of work area**
EH VS. DIELECTRIC OVERSHOES

• Dielectric shoes conform to **ASTM F1117, and are tested to ASTM F1116 at 20,000 Volts**, provide supplemental protection from step touch potential..., or when grounding and there is a voltage rise in other non-insulating floor coverings and wet surface areas.

• Salisbury’s yellow/black EH footwear comply with
  • ASTM F2413.

• Salisbury’s red/black dielectric footwear comply with
  • ASTM F1117.
Dielectric Boot Contamination Study, April 2017

- Honeywell Electrical Safety Dielectric boot Contamination (Mud) Study April 26, 2017

1. 51509 Control Pass
2. 51509 left Pass
3. 51509 left Pass
4. 51509 right Pass
5. 51509 right Pass
6. 21405WT 14 left Control Pass
7. 21405WT 14 left Pass
8. 21405WT 14 left Pass
9. 21405WT 14 right Pass
10. 21405WT 14 right Pass
11. 21405 9 left Pass
12. 21405 9 left Pass
13. 21405 9 right Pass
14. 21405 9 right Pass

Product tested to ASTM F1116 Standard 20KV for 1 – 3 minutes.
DIELECTRIC OVERSHOES OSHA 1910.269 & 1926.960

**What?** Dielectric Overshoes, short or tall boots available

**Who?** Workers exposed to step-touch potential; linemen, substation, troubleshooters, or contractors
INSULATED TOOLS & NON-SPARKING INSULATED TOOLS

✓ Tested to 10,000V, Max Use 1000V
✓ Must Have Two Color Coating if Coated Tool
✓ Must Show Symbol For Use in Live Voltage Situation

➤ Employees Shall Use Insulated Tools and/or Handling Equipment When Working Inside the Limited Approach Boundary of Exposed Live Parts Where Tools or Handling Equipment Might Make Accidental Contact.

➤ NFPA 70E and OSHA Require Insulated Tools When Working On or Near 50V + Equipment While Energized!
• Emergency Training
  • Employer shall document that employees required to respond to emergencies have received training in (1) and (2) below:
  • (1) Contact Release
    • Employees exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts.
  • (2) Resuscitation
    • Employees shall be regularly instructed in the method of first aid and emergency procedures, such as approved methods of resuscitation, if their duties warrant such training. Training of employees in approved methods of resuscitation, including cardiopulmonary resuscitations and automated external defibrillator (AED) use, shall be verified annually.
Contact Release

- **Contact Release:** “Employees exposed to shock hazards shall be trained in methods of safe release of victims from contact with exposed energized electrical conductors or circuit parts.” This insulated rescue hook is used to safely withdraw victims from contact with exposed energized electrical conductors or circuit parts.

- **Best Practice:** Rescue hooks are stored (with a rubber glove kit) on a safety board or mounted for easy retrieval near the work area: utility vehicle storage compartment, confined spaces, underground vault areas or electrical control rooms.

- **Insulated Rescue Hooks require re-testing every 2 years.** Live line tools (for example, hotsticks, switchsticks, shotgun sticks) must be wiped clean and inspected for defects before each day's use. Required to be inspected every 2 years for examination, cleaning, and any required testing. [See 1910.269(j)(2)(iii) and IEEE Std. 978, Guide for In-Service Maintenance and Electrical Testing of Live-Line Tools.] ASTM F711
General Care & Use Guidelines:

• All PPE must be inspected before each use! **Osha 1926.960**
  • Gloves/sleeves/blankets require electrical retesting intervals after placed in-service, In-service standards: ASTM F496 (gloves & sleeves), ASTM F479 (blankets)
    • Gloves, every 6 months
    • Blankets & Sleeves, every 12 months
  • Line Hose, Covers, Guards and Footwear require visual inspection before each use
    In-service standard: ASTM F478 (line hose & covers), and Product specification standard: ASTM F1117 (dielectric footwear)
  • Live line tools such as hot sticks, switch sticks, inspect before each use and retest every 2 years, In-service standard: ASTM F711
  • Grounding equipment inspect before each use & retest at regular intervals, ASTM F2249
• Insulated Tools, Product specification standard: ASTM F1505
• Arc Flash clothing & shields inspect for rips and wear before each use, Performance standards: ASTM F2178 (face shields) and ASTM F1506 (arc rated clothing)
Contact a Certified NAIL LAB for Retesting Product:

*Product is tested at the manufacturer before it is shipped according to ASTM / OSHA requirements. Manufacturer does not “retest product”.*

Contact a NAIL Lab for retesting and in-service testing requirements:
Gloves
Sleeves
Blankets
Covers
Sticks
Grounding
Boots
Line Hose

• Visit [www.nail4pet.org](http://www.nail4pet.org) for a list of certified re-test facilities in your area.
Inspection of Rubber Gloves, ASTM F496

Advantages:

• Gloves can be inspected with both hands
• Type I  NATURAL RUBBER GLOVES should not be stretched more than twice
• Type II  SYNTHETIC RUBBER gloves should not be stretched more than 1.25 times
Glove/Sleeve/Blanket Field Inspection

- Daily check inside/outside of gloves and sleeves, both sides of blankets

Gloves:
- Do gloves hold air? YES!

Gloves/Sleeves/Blankets:
- NO visible ozone checking or ozone cutting
- NO color changes, or contrasting colors
- NO visible holes, tears or punctures
- NO stickiness, or changes to texture
- Product is safe to use.

Best Practice: Follow company rules for removing rubber goods from service. Return to lab for further review and comment to help improve life of product.
Electrical Re-Testing of Gloves, ASTM F496

In-service standards:
ASTM F496 (gloves & sleeves) &
ASTM F479 (blankets)
  • Gloves, every 6 months
  • Blankets & Sleeves, every 12 months

• Visit www.nail4pet.org for a list of certified re-test facilities in your area.
Sizing of Rubber Gloves & Protectors = SYSTEM FIT

- To determine the proper size, measure the distance around the palm of the hand between the thumb and forefinger = RUBBER GLOVE SIZE
- Rubber glove should fit “snug” with protector properly so hands are not stressed
- Protectors should meet ASTM F696 relative to materials, thickness & markings
Arc Flash Clothing & PPE Care & Best Practices:

• Arc Flash clothing should be free from rips and excessive wear or petroleum products. **Performance standards:** ASTM F1506 (arc rated clothing)

• Arc Flash Face Shields: Inspect for cracks and proper functioning. **Performance Standards:** ASTM F2178 (face shields).

• Dielectric Footwear: Inspect for cuts, punctures or tears. **Performance Standards:** ASTM F1117 (dielectric footwear).
Grounding In-service Guidelines & Best Practices:

- Use EPZ; Equipotential Zone Grounding Practices **OSHA 1926.962(c)**:
  - A work zone where all conductors, structures and equipment are *grounded* and *bonded* together through a low resistance path to ground.
  - An **equipotential zone** is a work zone in which the worker is protected from electric shock from differences in electric potential between objects in the work area. These differences in potential can be caused by induced voltage, line re-energization, or lightning.

- Inspect grounds before each use, or before each work day. **ASTM F2249**

- Implement an In-service maintenance program for inspection, cleaning, and replacement. **ASTM F2249**. Best practice: Annually
Equipotential “ZONE”

- The “parallel” jumper only provides an EPZ for contacting the grounded phase/s.
- No protection is provided if contact made with other conductors outside the EPZ.
- “Bond” all conductive objects within reach or extended reach of the work area to the EPZ.
  - Guy wires
  - Messengers
  - Un-insulated trucks/booms
  - Etc...

Confirm Grounds and Cable Meet ASTM Standards ASTM F855

• Grounding components & cable should meet the specifications for material performance according to ASTM F855.
Check List For Building a Ground Assembly

• What ASTM Grade is required? Review ASTM F855-09 Table 1 & 2 and confirm (review with your engineering standards group):
  • Maximum fault current in kilo amperes (kA)
  • Time duration of fault in Cycles (15-or-30)

• Specify the clamps:
  • Minimum and maximum Conductor/Buss size to be grounded in inches, e.g. 1.25” max - .9” min
  • How many are needed, is this a Single leads or 4 Way set?
  • Style of clamp, “C”, Duck-Bill, Flat-Face, Angle, Ball Stud, etc…
  • Clamp jaw preference, Serrated or Smooth
  • Clamp termination style, Threaded or Pin type
  • Heat shrink, parking studs, etc…

• Specify the ferrules: The size of the ferrule must match the size of the cable it will be used with.

• Specify the cable gauge & length and of each ground lead
Rubber Goods Safety Program – Best Practice!

Truck Inventory Safety Checklist & Audit

Service Centers & Contractors, *what should be required to be available on every service truck at minimum?*

- Cat Id – Description – Quantity
  - Line Hose
  - Cable End Caps
  - Blankets, Class Type and Size
  - Hood Insulator Covers
  - Pole Guards
  - Glove Inflator
  - Face Shields, Arc flash Clothing
  - Gloves/Sleeves
  - Dielectric Footwear
Practice Safety & Wear Your PPE

Thank you!

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