MITCHELL & LINDSEY

· ELECTRICAL SAFETY SPECIALISTS ·

The Complete Electrical PPE Guidebook

Answers to all Your Questions About Arc Flash PPE

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Introduction

Working on and around live electrical equipment is dangerous! If you've been in maintenance or electrical contracting for any length of time, you already know this. Chances are high that you have been shocked before, maybe even severely. Chances are not as high that you have been in an arc flash incident, but an arc flash event is far more likely to cause severe injury or death.

According to NFPA, between 2012 and 2016, there were 9,760 electrical workplace injuries and 739 deaths. Not only are these human tragedies, but they result in lost time and money to the employer. This is one of the many reasons that studies show that companies with robust electrical safety programs are more profitable than companies with no plan. Regardless of the financial cost, too many workers are injured or killed working on live electrical equipment every year.

My intention is that this guidebook helps to clear up any confusion that you may have regarding how to protect you and your workers from electrical hazards. Most electrical workplace injuries are preventable. Nothing can ensure 100% safety, but a safety program with a commitment from the employer and the employee that includes training, principles, controls, procedures, and an effective PPE policy will almost guarantee a safe electrical environment. Hopefully, this is a small part of that program which provides you and your team with the educational tools necessary to protect your workers.

This book is a guide that you can use in selecting and utilizing Electrical Personal Protective Equipment. Keep this in mind. Electrical PPE is considered by NFPA to be the last resort in electrical safety. The most effective risk control will always be shutting it off. By shutting off the power, the worker eliminates the hazard.

However, if the power cannot be shut down and the live electrical work is justified, this guide will help you.

I want every worker to go home safely from work every day. If we can accomplish this, then there won't be any argument over statistics.

Bobby Lindsey
President - CESCP
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Who Decides on Electrical PPE Requirements?

Standards and Regulations

Before discussing potential electrical hazards, it is helpful to explain who defines the hazards and why. When it comes to workplace safety, OSHA is where it all starts. The Occupational Safety & Health Administration formed in 1971 as enforceable law, placing responsibility for worker's safety directly on the employer. For too long, workplace injuries and deaths were seen as part of the job. The Federal Government set out to change that. The OSHA Act covers most private sector employees and is the law. Violations of OSHA standards can lead to civil liability, criminal liability, and fines for the company.

The overall requirement from OSHA comes from the *General Duty Clause which states, "Each employer shall furnish to each of its employees, employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to its employees..."*

The General Duty Clause applies to all disciplines: electrical, mechanical, enclosed spaces, heights.... Standard 1910, Subpart S addresses electrical safety requirements specifically.

OSHA, however, has its limitations. It does not provide specificity in its requirements. OSHA is performance based and does not provide a prescription for safe work practices. It requires that the employers protect the employees from workplace hazards, but it doesn't say how.

This is where National Fire Protection Association comes into play. NFPA is prescription based and explains how to protect the workers. NFPA has existed since 1896 and now publishes over 300 consensus codes and standards.

The relevant codes and standards for the electrical industry include:

- ***National Electric Code (NFPA 70)***
- ***Recommended Practice for Electrical Equipment Maintenance (NFPA 70B)***
- ***Standard for Electrical Safety in the Workplace (NFPA 70E)***

It is in NFPA 70E where the prescriptions for electrical workers' safety resides. NFPA 70E is strictly focused on worker safety and does not prescribe procedures for the safety of the general public. It is also where you will find guidance and standards for Electrical Safety Programming, Establishing an Electrically Safe Work Condition, Lockout – Tagout, shock protection, arc flash protection, energized work permits...

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Why Do We Need Electrical PPE?

Electrical Hazards in the Workplace

NFPA 70E defines an electrical hazard as a dangerous condition such that contact or equipment failure can result in electric shock, arc flash burn, thermal burn, or arc blast injury. These types of injuries generally result from one of two events: shock or arc flash. To put it simply, we are trying to avoid being electrocuted or blown up. Shock and arc flash are different types of events, that have differing causes and require different types of protection strategies.

Shock

Shock Hazard is defined as a source of possible injury or damage to health associated with current through the body caused by contact or approach to energized electrical conductors or circuit parts. Shock occurs when current flows through or on the surface of the body. In a shock incident, the worker becomes part of the circuit. Shock can be as mild as a slight tingle on the skin or as serious as death, which is defined as electrocution. The magnitude of the electrical current, the path it takes through the body and the duration determine the severity. Shock injuries can come in the form of atrial fibrillation, internal burns to organs, or burns to the surface of the body and skin.

Arc Flash

Arc Flash Hazard is a source of possible injury or damage to health associated with the release of energy caused by an electric arc. An arc flash is the light and heat produced as part of an arcing fault from phase to ground or phase to phase. It results in super-heated air that can reach up to 35,000°F. This is over 3 times the temperature of the surface of the sun!

At these high temperatures, all matter is vaporized. When copper vaporizes it expands by a factor of 67,000. This expansion leads to a tremendous pressure build up and release. The heat and pressure can lead to discharge of molton metal, concussive sound, blinding light, and shrapnel. Being in an arc flash event is like being at ground zero of a bomb detonation, and the results can be devastating.

Temperature of 35,000°F can happen in as little as 1/100th of a second.

Effects of Current on the Body

Current Value Effects

< 1 ma	**Barely perceptible**
1-5 ma	**Perceptible shock, reflex actions**
5 ma	**Accepted as maximum harmless current**
6-10 ma	**Painful shock, victim can “let go”**
10-20 ma	**Painful shock, victim cannot “let go”**
50-100 ma	**Ventricular fibrillation possible**
100-200 ma	**Ventricular fibrillation likely**
200 ma	**Severe burns, severe muscular contractions, chest muscles clamp the heart and stop for the duration of the shock**
833 ma	**Current used by 100 watt light bulb**

Ventricular fibrillation is possible at as little as 50 ma, which is just 1/20th of an amp.

Shock and Arc Flash are two different types of events. Although the worker can be involved in both events at the same time, they are usually independent of each other. When a worker is shocked, most of the time it is not part of an arc flash event. When a worker is involved in an arc flash event, they are usually not shocked.

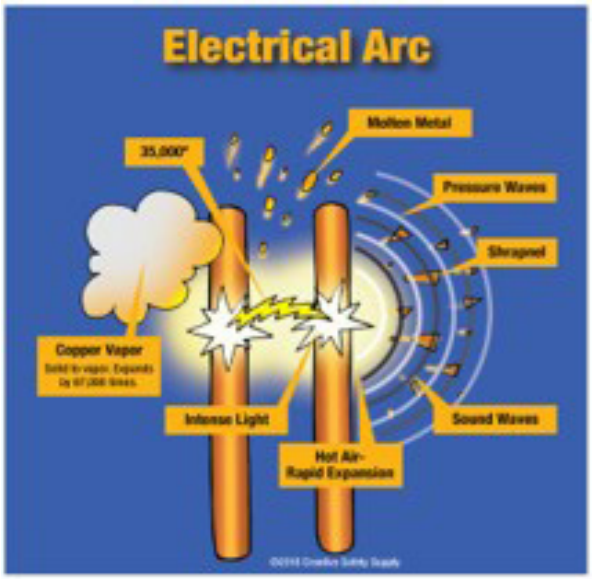
What Is Electrical PPE?

Personal Protective Equipment

Electrical PPE consists of clothing and equipment designed to protect us from shock, arc flash, and arc blast. Shock PPE provides insulation to protect against electrocution. Arc Flash PPE provides flame resistance to protect us from burns and Arc Blast PPE provides protection from debris, shrapnel, intense pressure, and loud noise. Take note that the PPE, particularly for arc blast, is limited in the protection it provides. It is designed to save our lives, not make us invincible.

Arc Flash PPE

If the arc flash and ensuing arc blast are intense enough, the entire body of the worker can be affected, therefore arc flash PPE is required to cover the worker from head to toe. Burns are the most common injury associated with an arc flash, but there is also risk from the pressure blast, molten metal, shrapnel, high decibel noise, blinding light and concussive force. The workers must protect themselves from all these possibilities and wear the proper PPE for any part of the body that is within the arc flash boundary, which will be discussed later in this guidebook.



Being close to an Arc Flash Event can be like being at ground zero of a bomb detonation.

Arc-Rated Clothing

Body protection is the easiest PPE to incorporate into a policy. The arms, torso and legs cover close to 80% of the human body and can be protected with a coverall or long-sleeve shirt and pants. You have the following options for body protection.

- **Arc-Rated (AR) shirt and pants combination**
- **AR coverall**
- **Waterproof versions of the above**

Arc Flash clothing is to be Arc Rated (AR) and is measured in calories/cm^2. Arc Rated means that it has been tested for exposure to arc flash. AR means that the clothing is flame resistant (FR), but FR does not mean that the clothing is AR. It must be tested in order to be AR.

When purchasing clothing, make sure of both of the following:

1. **The clothing meets ASTM F1506 for normal clothing and ASTM F1891 for rainwear.**
2. **The arc rating is measured in cal/cm^2 and the label contains the rating in either ATPV or EBT.**

Arc Rated

To be Arc Rated, the clothing must undergo testing. This testing results in a rating in cal/cm^2 followed by ATPV or EBT. These are defined below:

Arc Thermal Protection Value (ATPV)

The incident energy in cal/cm^2 on a material that results in 50% probability that sufficient heat transfer through the tested material is predicted to cause the onset of a second-degree burn injury based on the Stoll curve.

Breakopen Threshold Energy (EBT)

The incident energy on a material that results in a 50% probability of one or more holes in the material, allowing thermal energy to pass through. Breakopen is defined as a hole with an area of .5 inches squared or an opening of 1 inch in any dimension.

As a result, the material must show the incident energy in cal/cm^2 followed by ATPV or EBT in order to be arc rated. During testing, the testing company will use the lowest value to determine the arc rating. If the garment does not contain one of these abbreviations, it is not compliant with NFPA 70E requirements for arc flash PPE.

Layering

Layering the arc-rated clothing can be an effective way of increasing the arc rating and avoiding some of the more cumbersome PPE. Take note, however, that layering is not as simple as adding the arc rating of the different layers. The layered system requires testing or confirmation of the protection level from the supplier.

Undergarments

Underwear, under shirts, and socks do not have to be arc rated if arc-rated clothing is worn above the undergarments. However, all undergarments must be non-melting. Material such as polyester, spandex and other meltable material should not be worn anywhere on the body when working around arc flash hazards, even underneath arc-rated clothing.

Other tips

- **Sleeves must be fastened at the wrist.**
- **Shirts must be tucked into pants.**
- **Shirts, jackets or coveralls must be closed at the neck.**
- **Outerwear and other garments worn over arc-rated clothing must also be arc rated, but are not required to have an arc rating equal to or greater than the estimated incident energy.**
- **Make sure the clothing is loose fitting. Air provides thermal insulation.**

Arc Rating

The value attributed to materials that describes their performance to exposure to an electrical arc discharge. The arc rating is expressed in cal/cm2 and is derived from the determined value of the arc thermal performance value (ATPV) or energy of breakopen threshold (EBT) (should a material system exhibit a breakopen response below the ATPV value). Arc rating is reported as either ATPV or EBT, whichever is the lower value.

> *The arc rating of the equipment and clothing must meet or exceed the arc rating or arc flash hazard category of the equipment.*

Head Protection

Other than the hands and arms, the head and face are usually the closest body parts to an arc flash event. The PPE for the head and face are designed to protect from burns, blinding UV light, flying objects, shrapnel, molten metal and deafening sound. The PPE for the head protects the head, face, ears and eyes and includes:

Head and Face

A combination of balaclava, hard hat and arc flash face shield or an arc flash hood. The PPE should have an arc rating suitable for the hazard level. The balaclava protects the face and head from the heat. The hard hat protects from concussive forces and flying objects. The face shield is tinted to protect from the intense light. An arc flash hood accomplishes all of this and may be used instead of the face shield and balaclava and is required for higher level arc flash hazards.

Ears

Ear inserts protect from the high decibel level of noise caused from the blast. The best practice is to use ear canal inserts made of silicone rather than foam inserts or earmuffs.

Eyes

Safety glasses are still required underneath the face shield or arc flash hood.

Foot Protection

Heavy duty leather boots will suffice for adequate arc flash protection.

Hand Protection

Voltage-rated rubber gloves with leather protectors are primarily used for shock protection and have been around for a long time. However, NFPA 70E states that they can be used for arc flash protection.

Shock Protection

Shock protection is provided by PPE that creates an insulating barrier between the worker and the live part. The most common forms of shock PPE are rubber insulating gloves along with outer leather gloves coupled with insulated tools. The shock risk is measured primarily from the nominal system voltage: higher voltage = higher risk. As a result, all shock PPE will be voltage rated. In other words, it will contain a voltage level that identifies the level of protection the insulation provides.

Insulated Gloves

When the worker is engaged in live electrical work within the Restricted Approach Boundary, rubber insulating gloves with leather protectors are required. The size and thickness of the gloves are dependent on the voltage rating.

Voltage-rated gloves are the number one line of defense to protect the worker from shock, but working with them is not easy. As a result, many workers avoid using them. You can do 2 things to make it easier:

1. Utilize gloves that are rated at the lowest voltage rating necessary. If the highest voltage you are exposed to would be 480V, then buy Class 00 gloves, which are rated at 500V. I often see workers using gloves that are rated too high for the voltage at play. Using Class 2 gloves rated at 17,000 volts is not necessary in a building with a 480V system. Don't use oven mitts when snug fitting gloves will work. The chart below is your guide to purchasing the proper gloves.

2. Don't share a set of gloves with multiple workers. You wouldn't buy one set of work boots for sharing among your maintenance staff. Everyone has different sized hands and feet, so everyone should have their own properly sized set of gloves.

Shock protection is provided by a system of voltage-rated rubber gloves and leather protectors. The rubber gloves provide insulation from shock and the leather gloves go over the rubber gloves to provide protection from puncture.

ASTM Labeling Chart
Natural Rubber Electrical Insulating Gloves

Class Color	Proof Test Voltage AC/DC	Max. Use Voltage AC/DC	Insulating Rubber Glove Label
00 Beige	2,500 / 10,000	500 / 750	10
0 Red	5,000 / 20,000	1,000 / 1,500	10
1 White	10,000 / 40,000	7,500 / 11,250	10
2 Yellow	20,000 / 50,000	17,000 / 25,500	10
3 Green	30,000 / 60,000	26,500 / 39,750	10
4 Orange	40,000 / 70,000	36,000 / 54,000	10

The chart above is your guide to selecting the proper voltage-rated gloves. If your system is 480V, then Class 00 with a beige label is appropriate.

Using the lowest rated glove that you need and having the right sized glove for your hands will not eliminate the inconvenience of working with gloves, but it will make a huge difference. You should be able to use hand tools and voltage meters while wearing gloves that are properly rated and sized.

Insulated Tools

Like gloves, insulated tools are voltage rated and are required within the Restricted Approach Boundary. They provide an insulating barrier that prevents contact with live parts.

These tools contain stamping showing that they are voltage rated. If they don't contain this stamping, they should not be used for shock protection.

Insulated tool sets can come in many forms and sizes. You can purchase a Cadillac version that contains hundreds of pieces or just the basics. That is up to you.

Other Insulated Equipment

Other insulated equipment shall be used on any body parts that are exposed and are within the Restricted Approach Boundary. This can include:

Sleeves – must be rated for the voltage

Blankets – must be rated for the voltage

Covers – must be rated for the voltage

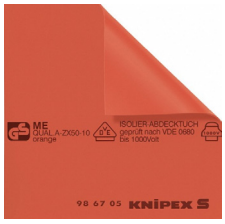
Line Hoses – must be rated for the voltage

Fuse Holders – must be rated for the voltage

Ropes and handlines – must be made of non-conductive material

Fiberglass reinforced plastic rods

Portable Ladders – must have non-conductive side rails when inside the Limited Approach Boundary



Rubber insulating gloves can be worn without leather protectors if all of the following apply:

- There is no risk of gloves being cut or damaged.
- The gloves are electrically retested before next use.
- The voltage rating is reduced by 50% for class 00 and by one whole class for classes 0-4
- There is no arc flash hazard.

Where is Electrical PPE Required?

Protection Boundaries

Now that we have discussed the PPE necessary to protect from shock and arc flash, it is time to explain when the PPE is required. Protection boundaries are used to guide the worker on when and where PPE is required. As we discussed earlier, there are two hazards that exist within the electrical environment: shock and arc flash. Each of these hazards have unique boundaries designed to protect and guide the worker.

Shock Boundaries

There are two boundaries in NFPA 70E related to shock protection: Limited Approach Boundary and Restricted Approach Boundary. Both shock boundaries are based on the nominal voltage of the system and can be found in Table 130.4 (E)(a) of NFPA 70E 2021.

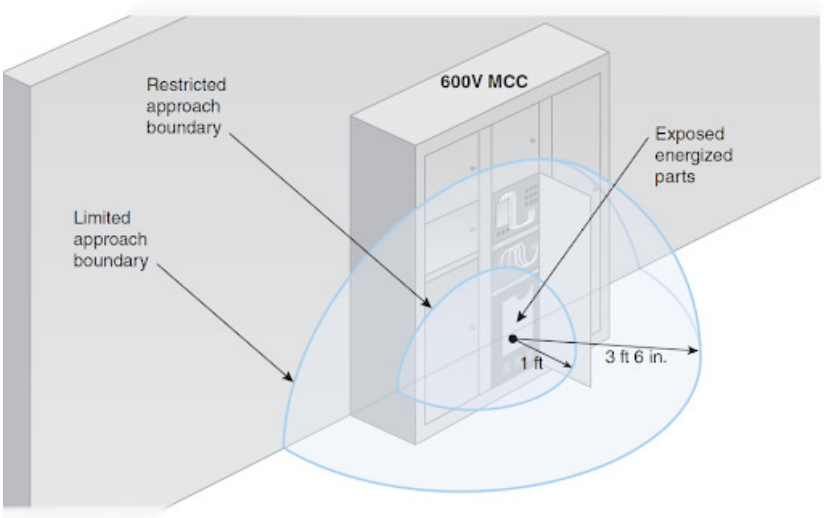
The ***Limited Approach Boundary*** is 3'6" for systems up to 750V and is the trigger point for qualified versus unqualified personnel. It is also within this boundary that electrical components are to be placed in an electrically safe work condition unless energized work is justified.

The ***Restricted Approach Boundary*** is the closest shock boundary. Unqualified personnel are not allowed within this boundary. It is also the boundary that triggers the use of shock PPE.

Arc Flash Boundary

Arc-Rated PPE is required for any part of the body that might enter the arc flash boundary. The arc flash boundary can be found on the arc flash label of the equipment or in tables found in NFPA 70E 130.7. (These tables will be explained later in this guidebook).

Each part of the body that might be within the boundary is to be protected with arc-rated clothing and equipment. Arc flash burns can still occur even with arc-rated equipment as the equipment is designed to make the event survivable. Arc-Rated PPE is designed to protect a worker up to 1.2 cal/cm^2, which is the threshold of a 2nd degree burn.

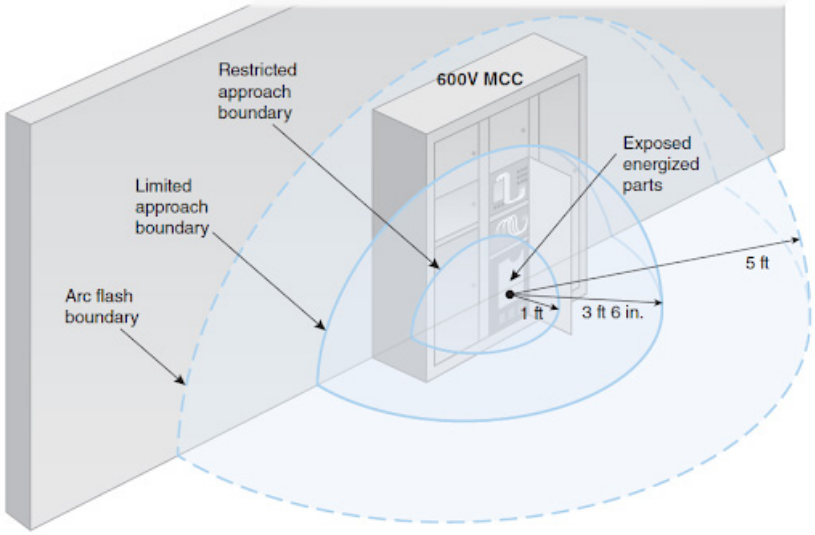


Limited Approach Boundary

- Unqualified Personnel are not allowed unless escorted & advised of hazards by a qualified person.
- Energized work beyond this point must be justified.

Restricted Approach Boundary

- Unqualified Personnel are not allowed.
- The worker must utilize insulated, voltage-rated PPE for shock protection.
- Energized work must be justified.



Arc Flash Boundary

Independent of the shock boundaries above, the shock boundaries are voltage dependent, whereas the arc flash boundary is incident-energy dependent. Therefore, the arc flash boundary may be the furthest boundary away from the live part or in between the shock boundaries.

When is Electrical PPE Required?

"Working On"

Electrical PPE is required whenever you are working on live electrical equipment. "Working On" is defined by NFPA 70E as "Intentionally coming in contact with energized electrical conductors or circuit parts with the hands, feet or other body parts, with tools, probes, or with test equipment, regardless of the personal protective equipment a person is wearing."

In the above definition, NFPA makes it clear that test equipment such as voltage meters are an extension of the body. Even if the hands aren't technically touching the live part, the probes you are holding in your hands are touching. That is considered "coming in contact with".

There are two categories of live electrical work or "working on." They are diagnostic and repair. Some examples of each are shown below.

Diagnostic

- Troubleshooting
- Voltage Reading
- Amp Reading
- Testing
- Moving conductors
- Opening MCC doors or buckets

Repair

- Changing a breaker
- Changing a fuse
- Tightening connections
- Landing Wire

This is a limited list as many other activities can fall into one of those categories.

The definition of "working on" above would lead you to believe that if the doors and covers are secured on the equipment, you are not going to come in contact with live circuit parts. Although this is true most of the time, you must consider other conditions. Ask yourself the following questions:

Is the equipment properly installed?

Is the equipment properly maintained?

Is the equipment being used in accordance with manufacturer's recommendations?

Are the equipment doors closed and secured?

Are the equipment covers in place?

Is there evidence of impending failure?

If the answer is 'yes' to any of the above, then PPE is still required.

How do I Select the Proper PPE

Methods for Selecting Arc Flash PPE

To select the appropriate arc flash PPE, the worker must know the hazard level. The arc flash label accomplishes this and provides the starting point for PPE selection. NFPA 70E requires warning labels that must contain the following:

1. Nominal System Voltage
2. Arc Flash Boundary
3. At least one of the following:

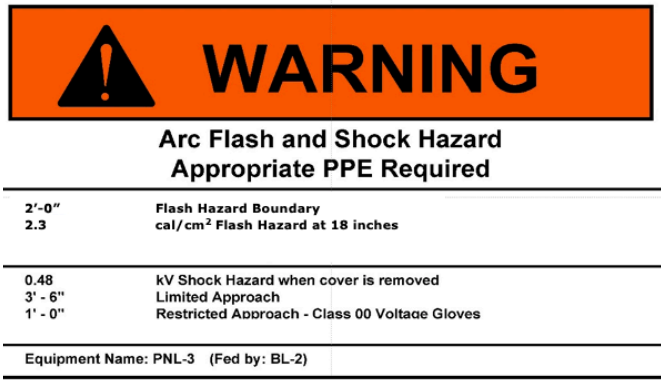
- **Available incident energy and the working distance OR the arc flash PPE Category, but not both**
- Minimum arc rating of clothing
- Site-specific level of PPE

Pay close attention to the orange italicized bullet point. This outlines the two methods for the selection of arc flash PPE:

1. The incident energy analysis method in accordance with table 130.5(G) of NFPA 70E 2021
2. The arc flash PPE category method in accordance with table 130.7 (C)(15)

Each of these methods has its pros and cons. I highly recommend the incident energy analysis method for reasons I will get to later, but first let's put each method side by side to compare the two on the following page.

Incident Energy Analysis Method



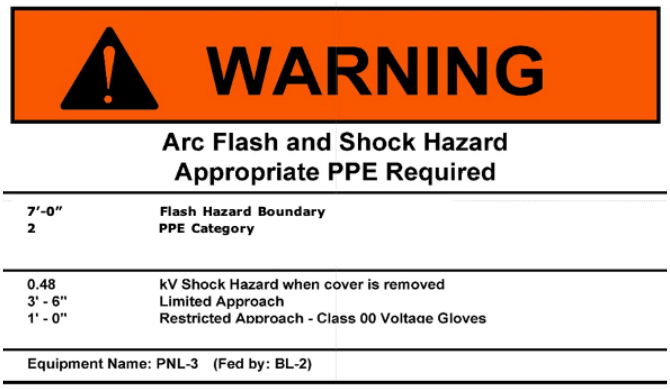
An arc flash risk assessment is performed in which the incident energy is calculated for all pieces of electrical equipment.

Remember, thermal energy is measured in cal/cm^2.

The worker then uses the incident energy on the label to select PPE that meets or exceeds this value. In the case of the label here, the worker would wear equipment rated to at least 2.3 cal/cm^2 and would use it for any body part that might be within the arc flash boundary which is shown as 2 feet.

Table 130.5(G) may be used as reference guide for the PPE required at certain incident energy levels.

Arc Flash PPE Category Method



This method involves a label containing the PPE Category as a number between 1 and 4 like the one shown here.

This method uses tables from NFPA 70E to categorize the risk level of equipment into categories 1 through 4. Each category protects up to a certain level of thermal energy measured in cal/cm^2.

In the case of this label, the worker would see PPE Category 2. This is then cross referenced with Table 130.7(C)(15)(a) for AC systems and Table 130.7(C)(15)(b) for DC systems to determine the Arc Flash PPE Category. Once determined, the worker cross references it with 130.7(C)(15)(c) to determine what PPE is needed.

Comparison of the Two Methods

Each selection method has its pros and cons, but keep in mind, only one method is allowed to be used on a piece of equipment, not both. The side-by-side comparison below outlines the advantages and disadvantages of both methods.

Incident Energy Analysis Method

Advantages

- More accurate method of determining risk
- Fewer tables involved
- Is part of an overall arc flash risk assessment
- Includes one-line drawings
- Allows for coordination study
- Allows for mitigation strategies to lower incident energy

Disadvantages

- Expensive to implement
- Calculations must be made when changes occur to the system

Arc Flash PPE Category Method

Advantages

- Does not require AF Study
- Can be estimated in the field if no arc flash label exists

Disadvantages

- Must know available fault current & clearing times
- Cannot be used if clearing times don't fall into table parameters
- Requires the use of up to 3 NFPA 70E tables
- Does not include drawings
- Does not include coordination study
- Does not investigate means of lowering arc rating

My recommendation is to go with the Incident Energy Analysis Method because of ease of use. It is much more user-friendly and accurate. In addition, you get the side benefits of having updated one-line drawings along with the ability to mitigate the incident energy down and reduce the hazard level.

Caring for PPE

All Personal Protective Equipment is to be:

- Maintained in a safe, reliable condition
- Stored in a manner to prevent damage
- Visually inspected before each use
- Used in accordance with manufacturer's recommendations and limitations

Arc Flash Clothing and Suits

- Arc-rated clothing should be inspected before each use and should not be used if contaminated with grease, oil, or flammable materials.
- When arc-rated clothing is cleaned, make sure that you follow the manufacturer's instructions on laundering
- Visually inspected before each use
- Used in accordance with manufacturer's recommendations and limitations

Shock PPE

Shock PPE is used to provide an insulating barrier between the worker and the live part. As such, the integrity of the insulation must be tested and certified at certain intervals. The table from NFPA 70E below outlines these testing intervals.

Table 130.7(C)(7)(b) Rubber Insulating Equipment, Maximum Test Intervals

Rubber Insulating Equipment	When to Test
Blankets	Before first issue; every 12 months thereafter*
Covers	If insulating value is suspect
Gloves	Before first issue; every 6 months thereafter*
Line hose	If insulating value is suspect
Sleeves	Before first issue; every 12 months thereafter*

*New insulating equipment is not permitted to be placed into service unless it has been electrically tested within the previous 12 months. Insulating equipment that has been issued for service is not new and is required to be retested in accordance with the intervals in this table.

Before using gloves

- Inspect the gloves for damage such as rips and tears
- Verify the last testing date
- Check the voltage rating
- Perform an air test to check for punctures and holes

To clean insulated gloves, you can use mild soap detergent. Don't use cleaning agents that contain solvents, oil or grease. You can use a glove powder to minimize sweat while wearing gloves. Don't use talc.

Keep it Simple

My Top 10 Takeaways

Practicing electrical safety does not need to hard and complicated. As a matter of fact, the simpler the better. That is how habits are formed, and I want you in the habit of being safe when working on electrical equipment. Here are the top 10 things to keep in mind.

1. Shut it off! If you can't justify working on live electrical equipment, then don't.

2. You are trying to protect yourself from injuries that are primarily the result of two types of events: shock and arc flash.

3. The hazard level for shock is dependent on voltage.

4. Shock Protection involves PPE that provides insulation from live parts.

5. The hazard level for arc flash is dependent on incident energy measured in cal/cm^2

6. Arc Flash Protection involves PPE designed to protect from heat by being flame resistant (FR) and arc rated (AR)

7. There are two methods you can use to select arc flash PPE.
   - Incident Energy Analysis Method
   - Arc Flash PPE Category Method

   You can use either, but not both on the same piece of equipment.

8. The trigger point for shock PPE is the Restricted Approach Boundary.

9. The trigger point for arc flash PPE is the Arc Flash Boundary.

10. The trigger point for qualified personnel is either the arc flash boundary or limited approach boundary, whichever is closest.

Arc Flash PPE Guidance

Incident Energy Analysis Method

Based on NFPA 70E Table 130.5(G)

<1.2

There is no requirement to provide the employee with Arc Flash Protection when the incident energy is estimated to be below 1.2 cal/cm^2 since the expected injury from an incident will be survivable and nonpermanent. However, it is not prohibited to provide protection for the employee at this level.

For Shock Protection
- Rubber insulating gloves with leather protectors when inside the Restricted Approach Boundary.

1.2 to 12

Arc Rating equal to or greater than the estimated incident energy

- Arc rated long sleeve shirt and pants or arc rated coverall or arc flash suit
- Arc rated face shield and balaclava or arc flash suit hood
- Hard hat with arc rated hard hat liner (as need)
- Safety glasses or safety goggles
- Hearing protection
- Rubber insulating gloves with leather protectors
- Leather footwear

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Arc Rating equal to or greater than the estimated incident energy

- Arc rated long sleeve shirt and pants or arc rated coverall or arc flash suit
- Arc rated arc flash suit hood
- Hard hat with arc rated hard hat liner (as needed)
- Safety glasses or safety goggles
- Hearing protection
- Rubber insulating gloves with leather protectors
- Leather footwear

Note: This chart is designed to illustrate the PPE requirements for protection against arc flash hazards. Electrical shock can still occur even when the risk of an arc flash event is low. Shock protection in the form of voltage rated gloves and insulated equipment should be utilized when the voltage is >50 volts regardless of the incident energy and arc flash risk. Disclaimer: This guide is for reference purposes and is not meant to replace any standard, regulation or electrical safety program principle. Reference NFPA 70E 2021 for full guidance on protective clothing and equipment.

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