

Electrical Safety-Related Work Practices

Introduction

- This program establishes MINIMUM standards to prevent hazardous electrical exposures to personnel and ensure compliance with regulatory requirements applicable to electrical systems
- Working on equipment in a **DE-ENERGIZED STATE** is **REQUIRED** unless de-energizing introduces an increased or additional hazard (see definitions)
- This program is designed to help ensure that **ENERGIZED** electrical work is performed safely by **QUALIFIED ELECTRICAL WORKER(s)**, who are trained and provided with the appropriate safe work procedures, protective equipment and other controls
- The program is intended to protect employees against
 - electrical shock,
 - Burns, and
 - other potential electrical safety hazardsas well as comply with regulatory requirements.

ELECTRIC HAZARDS

- Electricity-related hazards include: 1) electric shock and burns, 2) arc-flash burns, and 3) arc-blast impacts

1. Electric shock and burns

- An electric shock occurs when electric current passes through the body
- This can happen when touching an energized part
- If the electric current passes across the chest or head, death can result
- At high voltages, severe burns can result

2. Arc-flash burns

- An electric arc flash can occur if a conductive object gets too close to a high-amp current source or by equipment failure (for instance, while opening or closing disconnects)
- The arc can heat the air to temperatures as high as 35,000°F and vaporize metal in the equipment
- The arc flash can cause severe skin burns by direct heat exposure and by igniting clothing

3. Arc-blast impacts

- The heating of air and vaporization of metal creates a pressure wave that can damage hearing and cause memory loss (from concussion) and other injuries.
- Flying metal parts are also a hazard.

WARNING! This is NOT Arc-Flash Training

**This training is intended to provide you with
Shock Prevention and Protection Methods
as discussed in the facility's
Electrical Safety Related Work Practices**

PURPOSE of the ESRWPs

- Ensure the safety of employees who work on or near electrical hazards
- Ensure that employees understand and comply with safety standards related to electrical work
- Ensure that employees follow uniform practices during the progress of electrical work
- Comply with OSHA Standards according to the following six (6) points:
 1. Provide and demonstrate a safety program with defined responsibilities
 2. Determine the degree of arc flash hazard by qualified personnel
 3. Affix warning labels on equipment
 4. Provide personal protective equipment (PPE) for workers
 5. Provide documented training to workers on Lockout/Tagout procedures and the hazards of arc flash
 6. Provide appropriate tools for safe work

SCOPE

- This program applies to all company and contractor's electrical equipment and work performed by Employees and contractors regardless of job site location within the facility/property
- Working on **ONLY DE-ENERGIZED** equipment does NOT apply to company employee's whose **PRIMARY duties and responsibilities** relate to working on energized electric circuits, components, facilities. Those job titles are:

Electrician

- Their activities are addressed by the rules and regulations contained in various regulatory directives including the OSHA 29 CFR 1910, NFPA 70E and other locally generated procedures / processes

ELECTRIC SAFETY PRINCIPLES - **ENERGIZED** CONDITION

- **#1 - DE-ENERGIZE WHENEVER POSSIBLE!!!**
- A **WORK PERMIT** for working on live circuits, if such a scenario arises, **MUST** be used (See Appendix of program)

DRAFT
MUST be REVISED
for specific workplace

DEFINITIONS

Additional or Increased Hazard - Hazard created by de-energizing an electric circuit or component that results in:

- Interruption of LIFE SUPPORT equipment
- Deactivation of EMERGENCY ALARM systems
- Shutdown of HAZARDOUS LOCATION VENTILATION equipment

Authorized Lockout/Tagout Employee - Person who has completed the required LOTO training and is authorized to lockout (or tagout) a specific machine or equipment to perform service or maintenance.

De-energized electrical work - Electrical work that is performed on equipment that has been previously energized and is now **FREE FROM ANY ELECTRICAL CONNECTION** to a source of potential difference and from electrical charges.

DEFINITIONS

Disconnecting (or 'Isolating') switch - Device designed to close and/or open an electric circuit.

Dry location - Locations NOT normally subject to dampness or wetness, as in the case of a building under construction.

Energized electrical work - Repair, maintenance, troubleshooting, or testing on electrical circuits, components, or systems while energized (i.e., live).

ONLY Qualified Electrical Workers are permitted to work on energized circuitry of >50 volts to ground!!!!

DEFINITIONS

Energy source - Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Exposed electrical parts - Energized parts that can be inadvertently touched or approached nearer than a safe distance by a person. Parts NOT suitably guarded, isolated, or insulated. Examples include terminal contacts or lugs, and bare wiring.

Arc Flash Boundary - An approach limit distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur.

Ground Fault Circuit Interrupt (GFCI) - Device whose function is to interrupt the electric circuit to the load when a fault current to ground exceeds a predetermined value that is less than that required to operate the over-current protective device of the supply circuit.

DEFINITIONS

Ground - A conducting connection, whether intentional or accidental, between an electrical circuit or equipment and the earth or to some conducting body that serves in place of the earth.

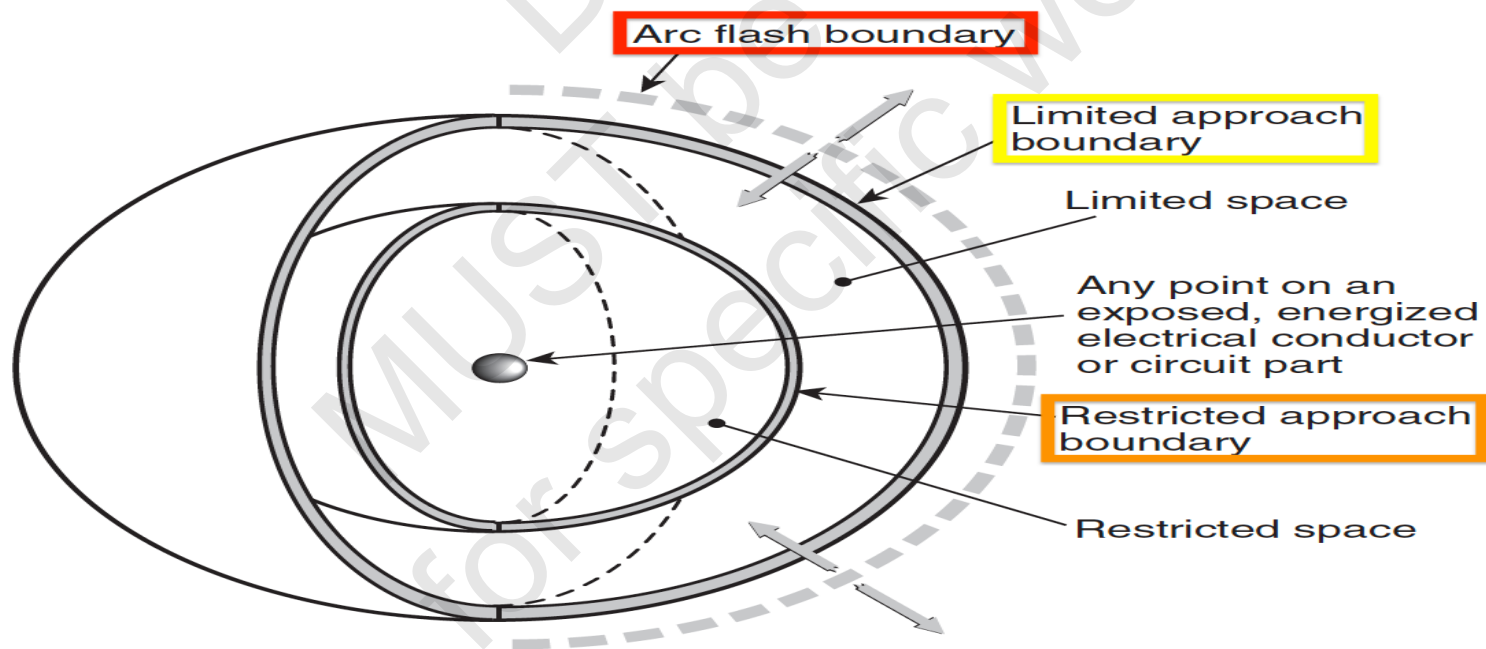
Life Safety Equipment - Equipment that provides critical protection for safety in the event of an emergency or other serious hazard. Life safety equipment, which is electrically energized, should be worked on using Energized Electrical Equipment (EEW) procedures to ensure that the protection provided by the equipment is NOT lost (e.g., fire alarm and evacuation).

Limited Approach Boundary — An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

DEFINITIONS

Lockout - The placement of a lock on an energy-isolating device according to procedure, ensuring that the energy isolating device and the equipment being controlled can NOT be operated until the lockout device is removed.

Restricted Approach Boundary - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.



DEFINITIONS

Qualified Electrical Worker – A qualified person trained and knowledgeable of construction and operation of equipment or a specific work method and is trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

Qualified electrical workers **MUST** be familiar with the proper use of the special precautionary techniques, personal protective equipment (PPE), including arc-flash, insulating and shielding materials, and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but is unqualified for others.

An employee who is undergoing on-the-job training and who, in the course of such training, has performed duties safely at his or her level of training and who is under the direct supervision of a qualified person may be considered to be qualified.

ONLY a Qualified Electrical Worker is allowed to work on energized circuits.

Qualified electrical workers **MUST NOT** be assigned to work alone, except for replacing fuses, operating switches, or other operations that do NOT require the employee to contact energized high voltage conductors or energized parts of equipment, clearing trouble, or emergencies involving hazard to life or property.

TRAINING

- Workers near energized, or potentially energized electrical circuitry greater than fifty (50) volts to ground, MUST be trained in energized electrical safe work practices and procedures and re-trained as necessary
- Affected Workers / Non-qualified Workers that could be near energized or potentially energized electrical circuitry greater than fifty (50) volts to ground MUST be trained to recognize the existence of hazards, proper work areas and the precautions taken to maintain worker safety in those areas

TRAINING - Qualified Electrical Worker

- **Qualified Electrical Worker** MUST receive training in avoiding the electrical hazards associated with working on or near exposed energized parts prior to performing energized electrical work
- Such training will be provided when the employee is **INITIALLY ASSIGNED** to the job and refresher training will be provided every **THREE (3) YEARS** **or** when changes occur
- The following items are to be included in the training of Qualified Electrical Workers:
 - LOTO, including safe work practices required to safely **DE-ENERGIZE** electrical equipment
 - Universal electrical safety procedures
 - Skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment
 - Perform on-the-job training with a qualified electrical worker
 - Skills and techniques necessary to determine the nominal voltage of exposed live parts
 - The approach distances specified in NFPA Table 130.4 and the corresponding voltages to which the qualified electrical worker will be exposed
 - Selection and use of proper work practices, personal protective equipment, tools, insulating and shielding materials and equipment for working on or near energized parts

TRAINING - Qualified Electrical Worker

- Qualified Electrical Workers **MUST** be also be trained in recognizing signs and symptoms of
 1. electric shock,
 2. heart fibrillation,
 3. electric burns, and
 4. proper first aid protocols for these conditions
 - a. Basic Cardiopulmonary Resuscitation (CPR);
 - b. Automatic External Defibrillator (AED); and
 - c. Contacting emergency personnel and basic first aid

TRAINING - Affected Worker / Non-qualified Worker

- Employees MUST receive training in **AVOIDING** the electrical hazards associated with working in the vicinity of or near exposed energized parts
- Such training will be provided when the employee is **INITIALLY HIRED**, and refresher training will be provided every **THREE (3) YEARS** or when changes occur
- The following items are to be included in the training of Affected Workers and / or Non-qualified Workers:
 - Explain the elements of the LOTO program
 - know that affected employees may NOT participate in lockout tagout
 - Recognize hazardous energy sources
 - Recognize possible results of uncontrolled energy

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

- Extension cords may ONLY be used to provide **TEMPORARY** power (less than 90 days)
- Portable cord-and-plug connected equipment and extension cords **MUST** be **VISUALLY** inspected before use ON ANY SHIFT for external defects such as loose parts, deformed and missing pins, or damage to outer jacket or insulation, and for possible internal damage such as pinched or crushed outer jacket.
 - Any defective cord or cord-and-plug-connected equipment **MUST BE REMOVED** from service and NO person may use it until it is repaired and tested to ensure it is safe for use.
- Extension cords MUST be of the three-wire type.
- Extension cords and flexible cords MUST be designed for hard or extra hard usage (for example, types S, SO, and ST). The rating or approval MUST be visible.

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

Cable Types							
Type	Description	Gauge Size Range	Number of Conductors	Insulation	Jacket	Voltage	Applications
S	Service	18 - 2 AWG	2 or more	Rubber	Rubber	600 Volts AC	Extra hard usage indoors
SO	Service Oil-Resistant	18 - 2 AWG	2 or more	Rubber	Neoprene	600 Volts AC	Extra hard usage indoors
ST	Service Thermoplastic	18 - 2 AWG	2 or more	PVC	PVC	600 Volts AC	Extra hard usage indoors

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

- Job-made extension cords are **PROHIBITED**
- Personnel performing work using extension cords or where work is performed in damp or wet locations **MUST USE** a ground-fault circuit interrupter (**GFCI**)
- Portable equipment **MUST BE HANDLED** in a manner that will NOT cause damage - electric cords connected to equipment **MUST NOT** be used for raising or lowering the equipment

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

The following requirements apply to the use of cord-and-plug-connected equipment and flexible cord sets (extension cords):

- Extension cords **MUST** be protected from damage
 - Sharp corners and projections **MUST** be avoided
 - Flexible cords may **NOT** be run through windows or doors unless protected from damage, and then **ONLY** on a temporary basis
 - Flexible cords may **NOT** be run above ceilings or inside or through walls, ceilings or floors
 - Flexible cords may **NOT** be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation
- Cords **MUST** be covered by a cord protector or tape when they extend into a walkway or other path of travel to avoid creating a trip hazard
- Extension cords used with grounding-type equipment **MUST** contain an equipment-grounding conductor (i.e., the cord **MUST** accept a three-prong, or grounded plug)

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

- Attachment plugs and receptacles may NOT be connected or altered in any way that would interrupt the continuity of the equipment grounding conductor
- Additionally, these devices may NOT be altered to allow the grounding pole to be inserted into current connector slots
 - Clipping the grounding prong from an electrical plug is PROHIBITED
- Flexible cords may ONLY be plugged into grounded receptacles
- The continuity of the ground in a two-prong outlet MUST be verified before use.
 - It is recommended that the receptacle be replaced with a three-prong outlet
- Adapters that interrupt the continuity of the equipment grounding connection may NOT be used

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

- **ALL** portable electric equipment and flexible cords used in highly conductive work locations, such as those with water or other conductive liquids, or in places where employees are likely to contact water or conductive liquids, **MUST BE APPROVED** for those locations
- Employee's hands **MUST BE DRY** when plugging and unplugging flexible cords and cord-and-plug connected equipment if energized equipment is involved
- If the connection could provide a conducting path to employee's hands (for example, if a cord connector is wet from being immersed in water), the energized plug and receptacle connections **MUST** be handled **ONLY** with **INSULATING PROTECTIVE EQUIPMENT** and by a **QUALIFIED ELECTRICAL WORKER**
- Locking-type connectors **MUST** be properly locked into the connector

PORTABLE ELECTRICAL EQUIPMENT AND EXTENSION CORDS

- Lamps for general illumination **MUST** be protected from breakage, and metal shell sockets **MUST** be grounded
- Temporary lights **MUST NOT** be suspended by their cords unless they have been designed for this purpose
- Portable lighting used in **wet or conductive locations**, such as tanks or boilers, **MUST** be operated at no more than 12 volts and **MUST** be protected by GFCI's
- Extension cords are TEMPORARY WIRING and **MUST** also comply with the section on "Requirements for Temporary Wiring" in this program

REQUIREMENTS FOR TEMPORARY WIRING

Temporary electrical power and lighting installations 600 volts or less, including flexible cords, cables and extension cords, may **ONLY** be used during and for **RENOVATION, MAINTENANCE, REPAIR, or EXPERIMENTAL** work

The duration for temporary wiring may **NOT EXCEED** 90 days

The following additional requirements apply:

- Ground-fault protection (e.g., ground-fault circuit interrupters or GFCI) **MUST** be provided on all **TEMPORARY-WIRING CIRCUITS**, including extension cords
- In general, all equipment and tools connected by cord and plug **MUST** be grounded
 - Listed or labeled double insulated tools and appliances need **NOT** be grounded
- Feeders **MUST** originate in an approved distribution center, such as a panel board, that is rated for the voltages and currents the system is expected to carry

REQUIREMENTS FOR TEMPORARY WIRING

The following additional requirements apply:

- Suitable disconnecting switches or plug connects **MUST** be installed to permit the disconnection of all ungrounded conductors of each temporary circuit
- Lamps for general illumination **MUST** be protected from accidental contact or damage, either by elevating the fixture above 8' or by providing a suitable guard
- Flexible cords and cables **MUST** be protected from accidental damage
 - Sharp corners and projections are to be avoided
- Flexible cords and cables **MUST** be protected from damage when they pass through doorways or other pinch points

WET OR DAMP LOCATIONS

- Work in *wet or damp work locations* (i.e., areas surrounded or near water or other liquids) should NOT be performed unless it is **ABSOLUTELY CRITICAL**
- Electrical work should be postponed until the liquid can be cleaned up
- The following special precautions **MUST** be incorporated while performing work in *DAMP LOCATIONS*:
 - ONLY use electrical cords that have GFCIs
 - Place a dry barrier over any wet or damp work surface
 - Remove standing water before beginning work
 - Work is **PROHIBITED** in areas where there is standing water
 - Do NOT use electrical extension cords in wet or damp locations, and
 - Keep electrical cords away from standing water



WORKING ON **DE-ENERGIZED** EQUIPMENT

Electrically Safe Condition

The most important principles of electrical safety are:

1. **ASSUME** ALL ELECTRIC CIRCUITS ARE ENERGIZED UNTIL **EACH** INVOLVED WORKER ENSURES THEY ARE NOT
2. EVERY CIRCUIT AND CONDUCTOR **MUST** BE TESTED **EVERY TIME** WORK IS DONE ON THEM
3. PROPER PPE MUST BE WORN UNTIL THE EQUIPMENT IS PROVEN TO BE DE-ENERGIZED
 - Voltage rated gloves and leather protectors MUST be worn
 - Electrically insulated shoes (EH Rated) MUST be worn or Approved insulating mats MUST be used
 - ANSI rated Safety glasses MUST be worn
 - Required Arc Flash PPE MUST be worn

WORKING ON **DE-ENERGIZED** EQUIPMENT

Electrically Safe Condition

***THE PROCESS OF DE-ENERGIZING IS "LIVE" WORK
AND
CAN RESULT IN AN ARC FLASH*** due to equipment failure

When de-energizing, follow ALL procedures described in
"Working On or Near Live Equipment"

WORKING ON **DE-ENERGIZED** EQUIPMENT

Electrically Safe Condition - Lockout/Tagout Program Summary

- After de-energizing, EACH employee at risk **MUST** apply an individual lockout/tagout device to EACH energy isolating device
 - Pushbuttons or selector switches can NOT be used as the **ONLY** way to de-energize
- Each person who could be exposed to electric energy **MUST HAVE EXCLUSIVE CONTROL** of the energy sources they are exposed to
- Before beginning work, EACH involved employee **MUST** verify through testing that all energy sources have been de-energized

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Working on live circuits means actually touching energized parts

Working near live circuits means working close enough to energized parts to pose a risk even though work is on de-energized parts

Common tasks where there may be a need to work on or near live circuits include:

- Taking voltage measurements
- Opening and closing disconnects and breakers
- Racking breakers on and off the bus
- Removing panels and dead fronts
- Opening electric equipment doors for inspection

Maintenance Department **MUST** have written procedures and **DOCUMENTED** training for these common tasks. For instance, when opening and closing disconnects, use the **left-hand rule** when possible (stand to the right side of the equipment and operate the disconnect switch with the left hand)

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Energized Electrical Work Permit

- If live parts are **NOT** placed in an *ELECTRICALLY SAFE CONDITION*, work to be performed **MUST** be considered **ENERGIZED ELECTRICAL WORK** and **MUST** be performed via a WRITTEN PERMIT issued by supervisor of the employees who will be doing the work.
- A copy of the Energized Electrical Work Permit can be found in the Appendix of the ESRWP
 - Work related to testing, troubleshooting, and voltage measuring may be completed without a permit PROVIDED APPROPRIATE safe work practices and PPE are used.

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Energized Electrical Work Permit

- The permit **MUST** be originated by the qualified electrical worker
- Energized Work Permits **MUST** be submitted to the appropriate supervisor for the employees who will be doing the work
- The permit **MUST** be posted in an appropriate location where the energized work is taking place for the duration of the task

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Energized Electrical Work Permit

ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER:

Job/Work Order Number _____

- (1) Description of circuit/equipment/job location: _____
- (2) Description of work to be done: _____
- (3) Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage: _____

Requester/Title _____

Date _____

PART II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS *DOING* THE WORK:

Check when
complete

- (1) Detailed description of the job procedures to be used in performing the above detailed work: _____ ☐
- (2) Description of the safe work practices to be employed: _____ ☐
- (3) Results of the shock risk assessment: _____
- (a) Voltage to which personnel will be exposed ☐
- (b) Limited approach boundary ☐
- (c) Restricted approach boundary ☐
- (d) Necessary shock, personal, and other protective equipment to safely perform assigned task ☐
- (4) Results of the arc flash risk assessment: _____
- (a) Available incident energy at the working distance or arc flash PPE category ☐
- (b) Necessary arc flash personal and other protective equipment to safely perform the assigned task ☐
- (c) Arc flash boundary ☐
- (5) Means employed to restrict the access of unqualified persons from the work area: _____ ☐
- (6) Evidence of completion of a job briefing, including discussion of any job-related hazards: _____ ☐
- (7) Do you agree the above-described work can be done safely? ☐ Yes ☐ No (If *no*, return to requester.)

Electrically Qualified Person(s) _____

Date _____

Electrically Qualified Person(s) _____

Date _____

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

Manufacturing Manager _____

Maintenance/Engineering Manager _____

Safety Manager _____

Electrically Knowledgeable Person _____

General Manager _____

Date _____

Note: Once the work is complete, forward this form to the site Safety Department for review and retention.

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Approach Distances to Exposed Live Parts

There are four (4) approach distances:

Shock Protection Boundaries - identified as *limited approach boundary* and *restricted approach boundary* and shall be applicable where personnel are approaching **EXPOSED ENERGIZED** electrical conductors or circuit parts.

Limited Approach Boundary - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which a shock hazard exists.

Restricted Approach Boundary - An approach limit at a distance from an exposed energized electrical conductor or circuit part within which there is an increased likelihood of electric shock, due to electrical arc-over combined with inadvertent movement.

Arc Flash Boundary - An approach limit distance from exposed live parts within which a person could receive a second degree burn if an electrical arc flash were to occur

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Approach Distances to Exposed Live Parts

There are four (4) approach distances:

To cross the **Restricted Approach Boundary**, the QUALIFIED PERSON MUST:

1. Have an ENERGIZED WORK PERMIT that is approved by the supervisor or manager responsible for the worker(s)
2. Use PPE suitable for working near exposed live parts and rated for the voltage and energy level involved
3. Be CERTAIN that NO part of the body enters the PROHIBITED space
4. Minimize the risk from unintended movement, by keeping as much of the body as possible out of the restricted space; body parts in the restricted space MUST be protected

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Approach Distances to Exposed Live Parts - **Limited Approach Boundary**

- Approach by UNQUALIFIED PERSONS
 - Unless permitted by #3 below, NO UNQUALIFIED PERSON is permitted to approach nearer than the **Limited Approach Boundary** of energized conductors and circuit parts
- Working at or Close to the **Limited Approach Boundary**
 - Where one or more UNQUALIFIED PERSONS are working at or close to the **Limited Approach Boundary**, the designated person in Charge of the workspace where the electrical hazard exists IS RESPONSIBLE for advising the unqualified person(s) of the electrical hazard and warn him or her to stay **outside** of the **Limited Approach Boundary**
- Entering the **Limited Approach Boundary**
 - Where there is a need for an unqualified person(s) to cross the limited approach boundary, a qualified person shall advise the unqualified person(s) of the possible hazards and continuously escort the unqualified person(s) while inside the limited approach boundary.
 - Under no circumstance shall unqualified person(s) be permitted to cross the **Restricted Approach Boundary**

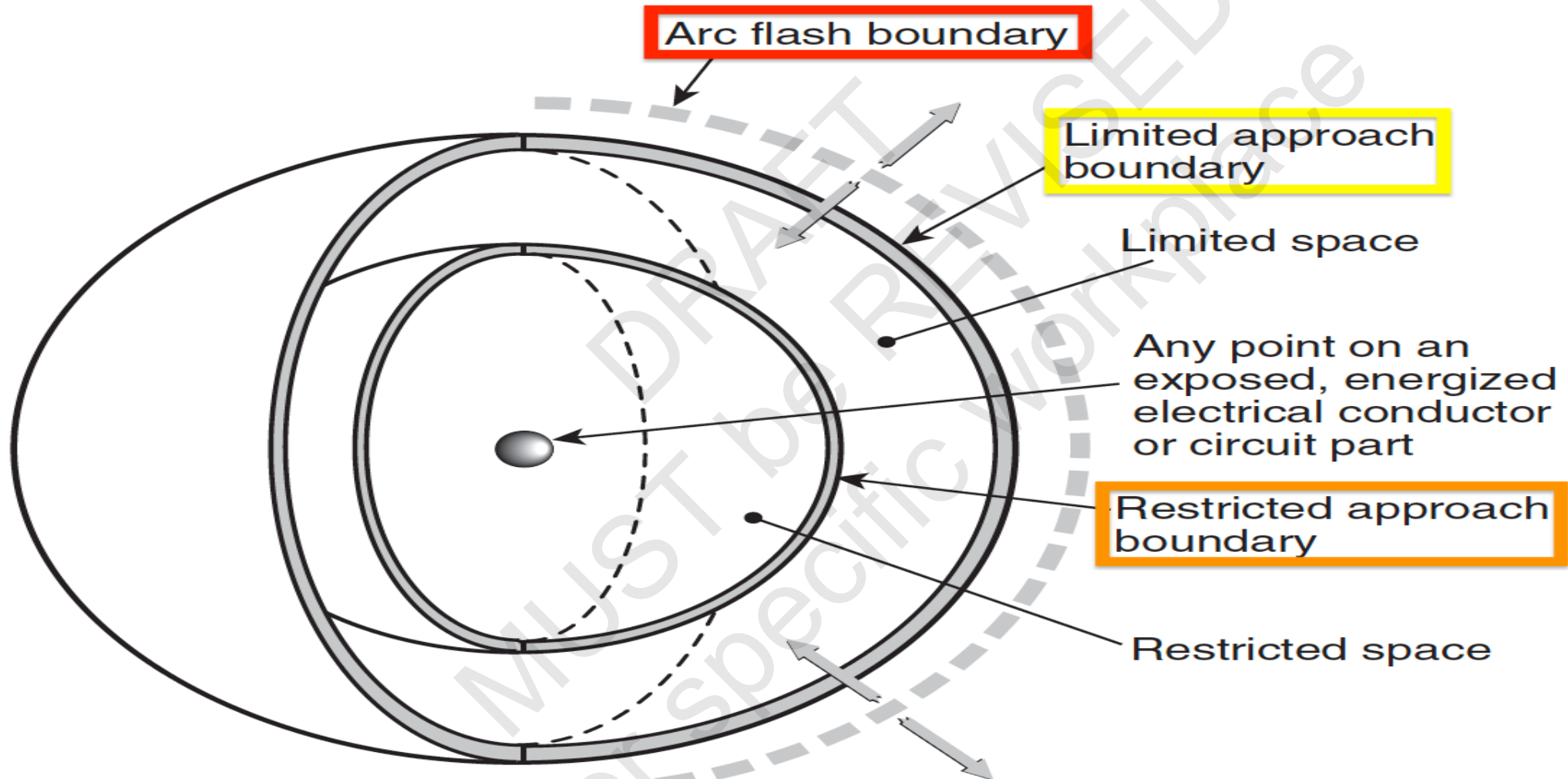
WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Approach Distances to Exposed Live Parts - **Restricted Approach Boundary**

- No QUALIFIED PERSON shall approach or take any conductive object closer to exposed energized electrical conductors or circuit parts than the **Restricted Approach Boundary**, unless one of the following conditions applies:
 1. The qualified person is insulated or guarded from energized electrical conductors or circuit parts operating at 50 volts or more.
 - Insulating gloves and sleeves are considered insulation ONLY with regard to the energized parts upon which work is performed.
 2. The energized electrical conductors or circuit parts are **insulated** from the qualified person **and from any other conductive object** at a different potential.

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Approach Distances to Exposed Live Parts



WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Approach Distances to Exposed Live Parts

- When working on de-energized parts, BUT still inside the **Arc Flash Boundary** for nearby live exposed parts:
 - If the parts can NOT be de-energized, barriers such as insulated blankets MUST be used to protect against accidental contact or proper PPE MUST be worn
 - NEVER reach blindly into areas that might contain exposed live parts
 - Illumination MUST be provided that allows the work to be performed safely
 - Conductive articles of jewelry and clothing MUST NOT be worn inside the arc flash boundary
 - Conductive materials, tools, and equipment that are in contact with any part of an employee's body MUST be handled in a manner that prevents accidental contact with live parts

Such materials and equipment include but are NOT limited to:

- | | |
|---|-------------------------|
| 1. long conductive objects such as ducts, pipes, tubes, hose rope | 4. metal scaffold parts |
| 2. metal-lined rules and scales, | 5. structural members |
| 3. steel tapes, pulling lines, | 6. chains |

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Equipment Labeling

Electrical equipment such as switchboards, panelboards, industrial control panels, meter socket enclosures, and motor control centers that are in other than dwelling units and that are likely to require examination, adjustment, servicing, or maintenance while energized shall be marked with a label containing all the following information:

1. Nominal system voltage
2. Arc flash boundary
3. At least one (1) of the following:
 - a. Available incident energy and the corresponding working distance OR the arc flash PPE category for the equipment
 - b. Minimum arc rating of clothing
 - c. Site-specific level of PPE

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - General Requirements

- Employees working in areas where there are potential electrical hazards **MUST** be provided with and use personal protective equipment (PPE) that is appropriate for the specific work to be performed
- 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
- The company will **PROVIDE** electrical protective equipment (Arc Flash Gear) required by this program
- Such equipment **MUST** include 11 calorie, and 40 calorie rated Arc Flash apparel (until a full arc flash hazard analysis is made), eye protection, head protection, hand protection, insulated footwear, and face shields where necessary

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT

Simplified Two-Category, Arc-Rated Clothing System

Clothing	Applicable Situations
Everyday Work Clothing Arc-rated long-sleeve shirt with arc-rated pants (minimum arc rating of 8) <i>or</i> Arc-rated coveralls (minimum arc rating of 8)	Situations where a risk assessment indicates that PPE is required AND where Table 130.7(C)(15)(a) and Table 130.7(C)(15)(b) specify arc flash PPE CATEGORY 1 or 2
Arc Flash Suit A total clothing system consisting of arc-rated shirt and pants <i>and/or</i> arc-rated coveralls and/or arc flash coat and pants (clothing system minimum arc rating of 40)	Situations where a risk assessment indicates that PPE is required and where Table 130.7(C)(15)(a) and Table 130.7(C)(15)(b) specify arc flash PPE CATEGORY 3 OR 4^B

This is a simplified approach to provide minimum PPE for electrical workers within facilities with large and diverse electrical systems. The clothing listed fulfills the **MINIMUM** arc-rated clothing requirements of Table 130.7(C)(15)(a), Table 130.7(C)(15)(b), and Table 130.7(C)(15)(c). The clothing systems listed in this table should be used with the other PPE appropriate for the arc flash PPE category.



WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT

Table 130.7(C)(15)(a) Arc-Flash PPE Categories for **Alternating Current (ac) Systems**

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Panelboards or other equipment rated 240 volts and below - Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	1	485 mm (19 in.)
Panelboards or other equipment rated greater than 240 volts and up to 600 volts - Parameters: Maximum of 25 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	900 mm (3 ft)
600-volt class motor control centers (MCCs) - Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
600-volt class motor control centers (MCCs) - Parameters: Maximum of 42 kA available fault current; maximum of 0.33 sec (20 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	4.3 m (14 ft)
600-volt class switchgear (with power circuit breakers or fused switches) and 600-volt class switchboards - Parameters: Maximum of 35 kA available fault current; maximum of up to 0.5 sec (30 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	4	6 m (20 ft)
Other 600-volt class (277 volts through 600 volts, nominal) equipment - Parameters: Maximum of 65 kA available fault current; maximum of 0.03 sec (2 cycles) fault clearing time; minimum working distance 455 mm (18 in.)	2	1.5 m (5 ft)
NEMA E2 (fused contactor) motor starters, 2.3 kV through 7.2 kV - Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT

Table 130.7(C)(15)(a) Arc-Flash PPE Categories for **Alternating Current (ac) Systems**

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Metal-clad switchgear, 1 kV through 15 kV - Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear 1 kV through 15 kV [for clearing times of less than 0.5 sec (30 cycles) with an available fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, 1 kV through 15 kV	N/A (doors closed)	N/A (doors closed)
Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4 (doors open)	12 m (40 ft)
Other equipment 1 kV through 15 kV	4	12 m
Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)		(40 ft)
Metal-clad switchgear, 1 kV through 15 kV - Parameters: Maximum of 35 kA available fault current; maximum of up to 0.24 sec (15 cycles) fault clearing time; minimum working distance 910 mm (36 in.)	4	12 m (40 ft)
Arc-resistant switchgear 1 kV through 15 kV [for clearing times of less than 0.5 sec (30 cycles) with an available fault current not to exceed the arc-resistant rating of the equipment], and metal-enclosed interrupter switchgear, fused or unfused of arc-resistant-type construction, 1 kV through 15 kV	N/A (doors closed)	N/A (doors closed)

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT

Table 130.7(C)(15)(b) Arc-Flash PPE Categories for Direct Current (dc) Systems

Equipment	Arc-Flash PPE Category	Arc-Flash Boundary
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than or equal to 100 V and less than or equal to 250 V Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in.)		
Available fault current less than 4 kA	2	900 mm (3 ft)
Available fault current greater than or equal to 4 kA and less than 7 kA	2	1.2 m (4 ft)
Available fault current greater than or equal to 7 kA and less than 15 kA	3	1.8 m (6 ft)
Storage batteries, dc switchboards, and other dc supply sources Parameters: Greater than 250 V and less than or equal to 600 V Maximum arc duration and minimum working distance: 2 sec @ 455 mm (18 in.)		
Available fault current less than 1.5 kA	2	900 mm (3 ft)
Available fault current greater than or equal to 1.5 kA and less than 3 kA	2	1.2 m (4 ft)
Available fault current greater than or equal to 3 kA and less than 7 kA	3	1.8 m (6 ft.)
Available fault current greater than or equal to 7 kA and less than 10 kA	4	2.5 m

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT

Summary of Specific Sections Describing PPE for Electrical Hazards	
Shock Hazard PPE	Applicable Section(s) 70E
Rubber insulating gloves and leather protectors, unless the requirements of ASTM F496 are met	130.7(C)(7)(a)
Rubber insulating sleeves as needed	130.7(C)(7)(a)
Class G or E hard hat as needed	130.7(C)(3)
Safety glasses or goggles as needed	130.7(C)(4)
Dielectric overshoes as needed	130.7(C)(8)

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT

Summary of Specific Sections Describing PPE for Electrical Hazards
Shock Hazard PPE
<i>Exposures GREATER THAN or Equal to 1.2 cal/cm² (5 J/cm²)</i>
Clothing: Arc-rated clothing system with an arc rating appropriate to the anticipated incident energy exposure
Clothing underlayers (when used): Arc-rated or nonmelting untreated natural fiber
Gloves: - Exposures GREATER THAN OR EQUAL to 1.2 cal/cm²(5 J/cm²) and LESS THAN OR EQUAL to 8 cal/cm² (33.5 J/cm²): heavy-duty leather gloves - Exposures GREATER THAN 8 cal/cm² (33.5 J/cm²): rubber insulating gloves with their leather protectors or arc-rated gloves
ANSI Hard hat: Class G or E
ANSI Face shield
ANSI EH Rated Footwear
<i>Exposures GREATER THAN OR EQUAL to 1.2 cal/cm²(5 J/cm²) and LESS THAN OR EQUAL to 12 cal/cm² (50.2 J/cm²)</i> - Arc-rated face shield that covers the face, neck, and chin, and - Arc-rated balaclava or an arc-rated arc flash suit hood

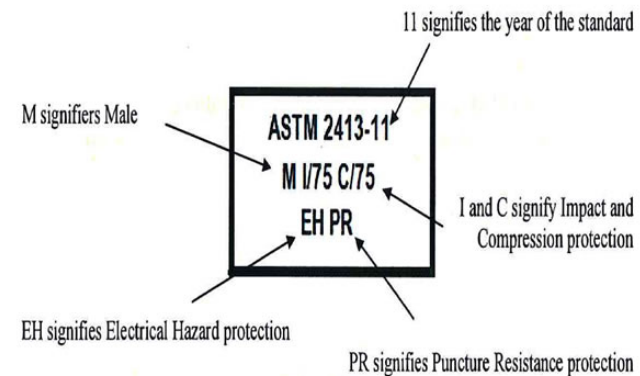
WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Summary of Specific Sections Describing PPE for Electrical Hazards

Exposures GREATER THAN 12 cal/cm² (50.2 J/cm²):

- arc-rated arc flash suit hood
- ANSI Safety glasses or goggles
- Hearing protection
- ANSI EH Rated Footwear:
 - Exposures LESS THAN OR EQUAL to 4 cal/cm² (16.75 J/cm²): Heavy-duty leather footwear (as needed)
 - Exposures GREATER THAN 4 cal/cm² (16.75 J/cm²): Heavy-duty leather footwear

Letters and numbers should be at least 3.75 mm tall



EXAMPLE ASTM F2413-11 LABEL

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Flame-Resistant Apparel & Underlayers

- FR apparel MUST be **visually inspected** BEFORE each use
- FR apparel that is contaminated or damaged MUST NOT be used.
 - Protective items that become contaminated with grease, oil flammable liquids, or combustible liquids MUST NOT be used
- The garment manufacturer's instructions for care and maintenance of FR apparel MUST be followed
- When the apparel is worn to protect an employee, it MUST cover all ignitable clothing and allow for movement and visibility
- FR apparel MUST cover potentially exposed areas as completely as possible.
- FR shirt sleeves MUST be **FASTENED, TAILS TUCKED** in at the waist and FR shirts/jackets MUST be **CLOSED AT THE NECK**

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Flame-Resistant Apparel & Underlayers

- **NON-MELTING** garments (i.e. cotton, wool, rayon, silk, or blends of these materials) **may be used as UNDER-LAYERS** beneath FR apparel
- Meltable fibers such as acetate, nylon, polyester, polypropylene, and spandex are **PROHIBITED UNDER-LAYERS**
 - An incidental amount of elastic used on non-melting fabric underwear or socks is permitted
- FR garments worn as **OUTER LAYERS** over FR apparel (i.e. jackets or rainwear) **MUST** also be FR
- Flash suits shall permit easy and rapid removal by the user

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Rubber Insulating Equipment

- Rubber insulating equipment includes protective devices such as:
 - gloves
 - sleeves
 - blankets and
 - matting
- Insulating equipment **MUST** be inspected for damage **BEFORE EACH DAY'S USE** and **IMMEDIATELY following ANY INCIDENT** that could have caused damage
- An **AIR TEST** **MUST** be performed on rubber insulating gloves **BEFORE EACH USE**
- Insulating equipment found to have defects that might affect its insulating properties **MUST** be removed from service until testing indicates that it is acceptable for continued use



WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Rubber Insulating Equipment

- Where the insulating capability of protective equipment is subject to damage during use, the insulating material **MUST BE PROTECTED BY AN OUTER COVERING OF LEATHER**
- Rubber insulating equipment **MUST BE TESTED** according to the schedule supplied by the manufacturer but can **NOT EXCEED SIX (6)** months
- Rubber insulating equipment shall be **STORED** in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage
- **Repairs** to rubber insulating equipment are **PROHIBITED**



WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Rubber Insulating Equipment

- Protector gloves **MUST** be worn over insulating gloves, except as follows:
 - **CLASS 0 GLOVES**, under **limited-use conditions**, when small equipment and parts manipulation necessitate unusually high finger dexterity.
 - Voltage does **NOT EXCEED** 250 volts, ac, or 375 volts, dc, **CLASS 00 GLOVES**, under **limited-use conditions**, when small equipment and parts manipulation necessitate unusually high finger dexterity
 - Any other Class of glove may be used without protector gloves, under limited-use conditions, when small equipment and parts manipulation necessitate unusually high finger dexterity but **ONLY IF THE EMPLOYER CAN DEMONSTRATE** that the possibility of physical damage to the gloves is small and if the class of glove is **ONE (1) CLASS HIGHER** than that required for the voltage involved
- Insulating gloves that have been used **WITHOUT** protector gloves may **NOT** be reused until they have been tested by a Qualified 3rd Party

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Rubber Insulating Equipment

- Insulating equipment with **ANY** of the following defects may **NOT** be used:
 - A hole, tear, puncture, or cut
 - Ozone cutting or ozone checking (that is, a series of interlacing cracks produced by ozone on rubber under mechanical stress)
 - An embedded foreign object
 - Any of the following texture changes:
 - swelling,
 - Softening or hardening, or
 - becoming sticky or inelastic
 - Any other defect that damages the insulating properties
- Insulating equipment shall be stored in such a location and in such a manner as to protect it from light, temperature extremes, excessive humidity, ozone, and other damaging substances and conditions



WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Rubber Insulating Equipment

Rubber Insulating Equipment Test Intervals

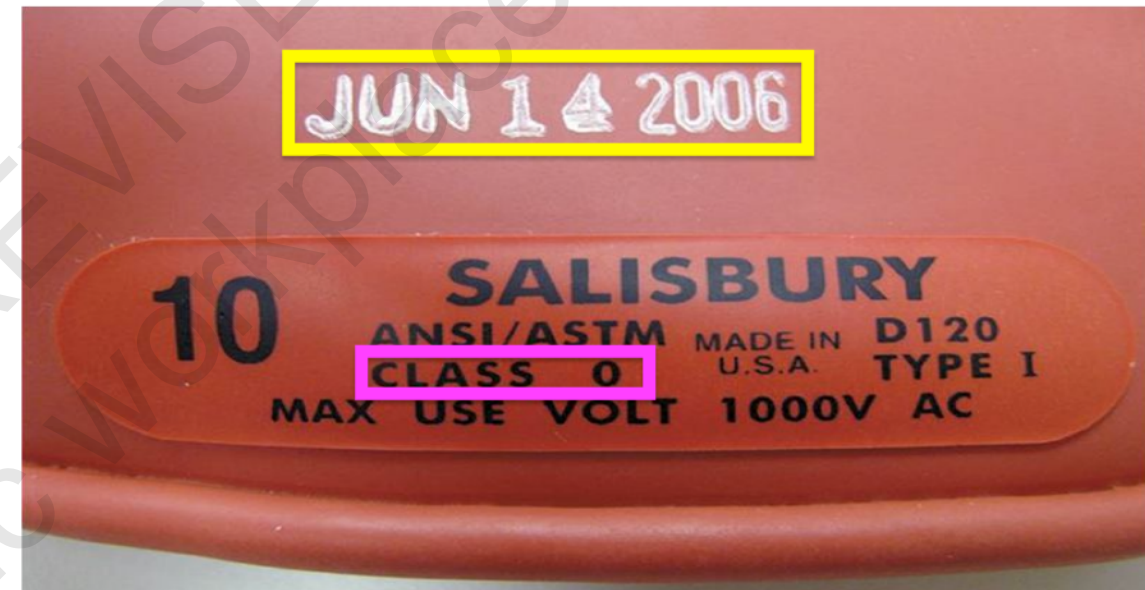
Type of equipment	When to test
Rubber insulating line hose	Upon indication that insulating value is suspect and after repair
Rubber insulating covers	Upon indication that insulating value is suspect and after repair
Rubber insulating blankets	Before first issue and every 12 months thereafter; ¹ upon indication that insulating value is suspect; and after repair
Rubber insulating gloves	BEFORE FIRST ISSUE and every 6 MONTHS thereafter; ¹ upon indication that insulating value is suspect; after repair; and AFTER USE WITHOUT PROTECTORS
Rubber insulating sleeves	Before first issue and every 12 months thereafter; ¹ upon indication that insulating value is suspect; and after repair

¹ If the insulating equipment has been electrically tested **but not issued for service**, the insulating equipment may not be placed into service **unless it has been electrically tested within the previous 12 MONTHS**.

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - *Manufacture and marking of rubber insulating equipment*

- Blankets, gloves, and sleeves shall be produced by a **SEAMLESS PROCESS**
- Each item shall be clearly marked as follows:
 - Class 00 equipment shall be marked Class 00 (500 volts)
 - Class 0 equipment shall be marked **Class 0 (1,000 volts)**
 - Class 1 equipment shall be marked Class 1 (7,500 volts)
 - Class 2 equipment shall be marked Class 2 (17,000 volts)
 - Class 3 equipment shall be marked Class 3 (26,500 volts)
 - Class 4 equipment shall be marked Class 4 (36,000 volts)
 - Nonozone-resistant equipment shall be marked
 - Ozone-resistant equipment shall be marked Type II
- Other relevant markings, such as the manufacturer's identification and the size of the equipment, may also be provided
- Markings shall be **NONCONDUCTING** and shall be applied in such a manner as not to impair the insulating qualities of the equipment
- Markings on gloves shall be confined to the **CUFF PORTION** of the glove



WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

PERSONAL PROTECTIVE EQUIPMENT - Insulated Tools and Materials

- ONLY insulated tools and equipment shall be used within the **Limited Approach Boundary** of exposed energized parts
- Insulated tools **MUST** be
 1. rated for the VOLTAGES on which they are used
 2. designed and constructed for the environment to which they are exposed and the manner in which they are used
- Fuse or fuse holder handling equipment, insulated for the circuit voltage, **MUST** be used to **removed or install a fuse** if the fuse terminals are **ENERGIZED**
- Ropes and hand-lines used near exposed energized parts **MUST** be **NONCONDUCTIVE**
- Portable ladders used for electrical work **MUST** have **NONCONDUCTIVE SIDE RAILS** (e.g. fiberglass ladders are permitted - **WOODEN LADDERS** are **NOT**)

WORKING ON OR NEAR **ENERGIZED** EQUIPMENT

Access Limiting Equipment

- Barricades MUST be used in conjunction with safety signs to prevent or limit access to work areas containing live parts
 - Conductive barricades are **PROHIBITED**
- Barricades MUST be placed no closer than the **Limited Approach Boundary**
- If signs and barricades do NOT provide sufficient protection, an attendant will be assigned to warn and protect pedestrians
- The primary duty of the attendant MUST be to keep an unqualified person out of the work area where an electrical hazard exists
- Attendant MUST remain at the **Limited Approach Boundary** as long as there is a potential exposure to electrical hazards