

Safety Manual

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Electrical Safety

Purpose

The purpose of this policy is to provide minimum guidelines for safety-related work practices to ensure a safe and healthful work environment is provided for North Carolina Agricultural and Technical State University (NC A&T) employees who may be exposed to electrical circuits or electrical hazards.

Scope

The University has utilized OSHA Standards 1910.331 through .335 and the NFPA 70E *Standard for Electrical Safety in the Workplace* in the development of this requirement. It applies to state employees both qualified (those familiar with the construction and operation of electrical equipment, the hazards involved and who have training in avoiding the electrical hazards of working on or near energized parts) and unqualified (those with little or no such training) who work on, near or with electrical circuits, except where qualified employees are excluded.

Responsibilities

Environmental Health and Safety (EHS)

EHS is responsible for reviewing hazards associated with electrical safety during annual shop inspections. EHS is responsible for reviewing and updating the Electrical Safety Policy. EHS will assist departments in implementing the provisions of this program and developing task specific training and procedures. EHS and Supervisors also work jointly in the development of Job Safety Analysis (JSA) to document first-time procedures.

Supervisor and Employee

Supervisors are responsible for implementing the Electrical Safety Program within their areas and ensure employees comply with the program. Supervisors develop and maintain a list of all qualified employees in their areas. They must ensure employees are provided with and use appropriate protective equipment. Supervisor led training is required upon employment for employees who may be exposed to electrical circuits or electrical hazards. An excellent means of conducting this training is to develop a JSA that covers the pertinent information on how to properly and safely use these types of tools and equipment with machine safeguards.

Employees must perform electrical work in accordance with this program. They must conduct a visual inspection of personal protective equipment (PPE), equipment and tools prior to each use to ensure good working condition. Employees must notify their supervisor if PPE, equipment or tools are found to be defective. They must also keep unqualified people outside of the qualified worker boundary.

Work Practices

Safe work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect contact with electrically energized equipment or circuits. The specific safety related work practices shall be consistent with the nature, extent and voltage of the

associated electrical hazards. Campus departments must develop specific procedures to address work practices specific to their work environments.

De-Energized Parts

Before employees may be exposed to work on or near live parts or circuits they must be placed into an electrically safe work condition (i.e., de-energized) unless the employer can demonstrate that de-energizing introduces additional or increased hazards or is unfeasible due to equipment design or operational limitations. Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs. An electrical hazard is present until an electrically safe work condition exists.

Working on or near exposed de-energized parts

Employees working on de-energized parts or near enough to them to expose the employee to any electrical hazard they present, must follow the following safety work practices:

- Conductors and parts of electric equipment that have been de-energized but have not been properly locked out or tagged out shall be treated as energized.
- Lockout and Tagging: While any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged out or both (see the Lockout/Tagout Requirements section of this Manual).

Procedures for de-energizing equipment

The following procedures shall be followed for de-energizing equipment:

- Safe procedures for de-energizing circuits and equipment shall be determined before circuits or equipment are de-energized.
- All possible energy sources must be identified for the involved circuits and equipment. Check applicable up-to-date drawings, diagrams, and identification tags. Control circuit devices, such as push buttons, selector switches, and interlocks, may not be used as the sole means for de-energizing circuits or equipment. Interlocks for electric equipment may not be used as a substitute for lockout and tagging procedures.
- Stored electrical energy which might endanger personnel is released such as discharging capacitors and short-circuiting and grounding high capacitance elements, if the stored electrical energy might endanger personnel. If the capacitors or associated equipment are handled in meeting this requirement they are treated as energized.
- Stored non-electrical energy (hydraulic, pneumatic, etc.) in devices that could re-energize electric circuit parts shall be blocked or relieved to the extent that the circuit parts cannot be accidentally energized by the device (see the Lockout/Tagout Requirements section of this Manual).

Verification of de-energized condition

The following requirements shall be met before any circuit or equipment is considered de-energized or worked on as de-energized.

- A qualified person operates the equipment, operating controls or otherwise verifies that the equipment cannot be restarted.
- A qualified person uses test equipment to test the circuit elements and electrical parts of equipment to which employees will be exposed and verifies that the circuit elements and equipment parts are de-energized. The test shall also determine if any energized condition exists because of inadvertently induced voltage or unrelated voltage back feed even though specific parts of the circuit have been de-energized and presumed to be safe.

- A three-step testing procedure should be used for voltage: 1) Test a known source to verify the tester is operating properly; 2) Use tester to confirm that the equipment has zero voltage; and 3) Test a known source again to verify the tester is operating properly.

Re-energizing equipment

The following requirements shall be met, in the order given, before circuits or equipment are re-energized, even temporarily.

- A qualified person conducts test and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds and other such devices have been removed, so that circuits and equipment can be safely energized.
- Employees exposed to the hazards associated with re-energizing the circuit or equipment shall be warned to stay clear of circuits and equipment.
- Each lock and tag shall be removed by the employee who applied it or under his or her direct supervision. However, if the person is absent from the workplace, then the lock or tag may be removed by a qualified person designated to perform this task provided that the supervisor ensures the person who applied the lock or tag is not available at the workplace, ensures that the employee is aware that his or her tag has been removed before he or she resumes work at that workplace, and a visual determination is made to ensure that all people are clear of the circuits and equipment.

Energized Parts

The Electrical Safety Program is based on the principle of avoiding energized work unless it is necessary. All other possibilities for establishing an electrically safe work condition must be exhausted before working on or near exposed energized parts. If exposed live parts **are not de-energized** (i.e., for reasons of increased or additional hazards or unfeasibility), other safety related work practices shall be used to protect employees who may be exposed to the electrical hazards involved. Such work practices shall protect employees against contact with energized circuit parts directly with any part of their body or through some other conductive object. The work practices that are used shall be suitable for the conditions under which the work is to be performed and for the voltage level of the exposed electric conductors or circuit parts.

Working on or near exposed energized parts

The following is required when work is performed on exposed live parts and employees are involved either in direct contact or by means of tools, or materials or near enough to live parts for employees to be exposed to any hazard they present. Only qualified persons may work on electric circuit parts or equipment that have not been de-energized. The qualified person shall can work safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools.

Justification

Justification is required for working on or near exposed energized parts. Employees are exposed to an electrical hazard always when they are within the limited approach and/or arc flash boundary. Therefore, the employer must be able to demonstrate that the work cannot be performed with the equipment in an electrically safe work condition. Only the following explanations for not creating an electrically safe work condition are acceptable:

- De-energizing creates an additional hazard or increased risk. Examples of additional hazard or increased risk include, but are not limited to, interruption of life-support equipment, deactivation of emergency alarm systems, loss of power will result in an environmental spill, or shutdown of a hazardous location's ventilation system.

- The task to be performed is infeasible in a de-energized state due to equipment design or operational limitations. If it is not possible to de-energize the exposed energized parts by performing the work at a different time, then the work task is infeasible to perform in an electrically safe work condition. Examples of infeasibility include, but are not limited to, performing diagnostics and testing to troubleshoot electrical circuits that can only be performed with the circuit energized or working on circuits that form an integral part of a continuous process that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.
- Exposed energized electrical parts that operate at less than 50 volts where it is determined that there will be no increased exposure to electrical burns or to explosion due to electric arcs. If voltage is less than 50 volts, only the shock hazard is not present. Other hazards such as a thermal or pressure hazard may be present in the event of a short-circuit condition (e.g. batteries).

Energized electrical work permit

If live parts are not placed in an electrically safe condition, work to be performed shall be considered energized electrical work and will be performed by written permit only. The permit allows employees, managers and equipment owners opportunity to recognize the increased exposure to electrocution or a thermal hazard and decide based on the conditions that exist in the field. The qualified worker performing the work must sign the permit which provides authority for the worker to be involved in determining the need for a task to be performed on energized parts.

The energized electrical work permit shall include, but not limited, to the following items:

- Description of the circuit and equipment to be worked on and location
- Justification for why the work must be performed energized
- Description of the safe work practices to be employed
- Results of shock hazard analysis
 - Limited approach boundary
 - Restricted approach boundary
 - Prohibited approach boundary
 - Necessary personal protective equipment
- Results of arc flash hazard analysis
 - Available incident energy or hazard/risk category
 - Necessary personal protective equipment
 - Arc flash boundary
- Means to restrict access of unqualified persons from the work area
- Evidence of completion of a job briefing, including any job-specific hazards
- Energized work approval signatures

The following links provide an example of an [Energized Electrical Work Permit](#) and [Energized Electrical Work Permit Flow Chart](#).

Exception: Work related to testing, troubleshooting, and voltage measuring may be completed without a permit provided appropriate safe work practices and PPE are used. In general, these tasks require equipment or circuit to be energized. Employees conducting these tasks should be specifically chosen based on their knowledge and skill.

Electrical hazard analysis

If energized parts operating at 50 volts or more are not placed in an electrically safe work condition, then both a shock and arc flash analysis are required before any person is permitted to approach the exposed energized parts. The shock hazard analysis is intended to determine if a risk of electrocution or shock might exist when the work task is being executed. The analysis must determine if work practices and PPE reduce the risk of electrocution to an acceptable level. An arc flash analysis must determine if the employee could be exposed to the extreme temperature generated by the electrical current during an arcing fault. The analysis must determine the flash protection boundary and the rating of the PPE.

Shock hazard analysis

A shock hazard analysis shall determine the voltage to which personnel will be exposed, the boundary requirements, and the PPE to minimize the possibility of electric shock. The boundaries are determined by the maximum voltage to which an employee might be exposed. Shock boundaries are related to direct contact with energized parts and do not consider exposure to arc flash. Tables 130.4(C)(a) and 130.4(C)(b) in the NFPA 70E standard are used to determine the following boundaries:

- **Limited approach boundary:** The closest approach distance for an unqualified employee unless protective measures are used. A qualified worker must escort the unqualified worker always while working inside this boundary.
- **Restricted approach boundary:** The closest approach distance for a qualified employee unless additional protective measures are used.
- **Prohibited approach boundary:** Boundary that must not be crossed unless energized safe work practices are used such as wearing appropriate PPE.

Arc flash hazard analysis

An arc flash hazard analysis shall be conducted to determine the arc flash boundary, the incident energy at the working distance, and the PPE required within the arc flash boundary. Methods such as calculating the incident energy or using Tables 130.7(C)(15)(a), 130.7(C)(15)(b), and 130.7(C)(16) in the NFPA 70E Standard. The analysis must be updated when a major modification or renovation takes place. It shall be reviewed at least every 5 years.

Equipment labeling

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

- At least one of the following:
 - Available incident energy and the corresponding working distance
 - Minimum arc rating of clothing
 - Required level of PPE
 - Highest Hazard/Risk Category (HRC) for the equipment
- Nominal system voltage
- Arc flash boundary

The method of calculating and data to support the information for the label shall be documented.

Other Precautions for Personnel Activities

Overhead Lines: When work is to be performed near overhead lines, the lines shall be de-energized and grounded or other protective measures shall be provided before work is started. If the lines are to be de-energized, arrangements shall be made with the electric utility

company, person or organization that operates or controls the electric circuits involved to de-energize and ground them. If protective measures, such as guarding, isolating, or insulating, are to be provided, these precautions shall prevent employees from contacting such lines directly with any part of their body or indirectly through conductive materials, tools, or equipment. Only qualified persons of the electric utility, power transmission and distribution organizations can install insulating devices on overhead power transmission and distribution lines.

Illumination: Employees shall not enter spaces containing exposed energized parts, unless illumination is provided which enables the employees to perform the work safely. Employees are not to perform tasks on or near exposed energized parts where there is a lack of illumination or an obstruction which precludes observation of work to be performed. Install temporary lighting for areas with low illumination. Additional lighting may be required due to darkness of a face shield.

Blind Reaching: Employees shall not reach blindly into areas that might contain exposed live parts.

Confined or Enclosed Work Spaces: Prior to entry employees must be trained in the confined space entry requirements. For employees working in confined or enclosed spaces such as manholes or vaults that contain exposed energized parts, the department shall provide and the employee shall use protective shields, protective barriers, or insulating materials as necessary to avoid inadvertent contact with these parts. Doors, hinged panels and the like shall be secured to prevent their swinging into an employee and causing the employee to contact exposed energized parts.

Conductive Materials and Equipment: Conductive materials or equipment that is in contact with any part of an employee's body shall be handled in a manner that will prevent the employee from contacting exposed energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in areas with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.

Portable Ladders: All portable ladders shall be nonconductive if they are used where the employee or the ladder could contact exposed energized parts. (See Stairways and Ladder section of this Safety Manual for additional requirements on the use, maintenance and storage of ladders.)

Conductive Apparel: Employees are not allowed to wear conductive articles of jewelry and clothing such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear if they might contact exposed energized parts. However, such articles may be worn if rendered nonconductive by covering, wrapping, or other insulating means.

Housekeeping Duties: Housekeeping duties shall not be performed close enough for possible contact with live parts, unless adequate safeguards such as insulating equipment or barriers are provided.

Electrically conductive cleaning materials including conductive solids such as steel wool, metalized cloth, and silicon carbide, as well as conductive liquid solutions shall not be used near energized parts unless procedures are followed which prevent electrical contact.

Interlocks: Only qualified persons can defeat an electrical safety interlock following the above specified procedures for working on or near exposed energized parts, and then only temporarily while they are working on the equipment. Also, the interlock system will be returned to its operable condition when this work is completed and verified to be operational.

Occasional use of flammable or ignitable materials: Where flammable or ignitable materials are present only occasionally, electric equipment capable of igniting them shall not be used unless measures are taken to prevent hazardous conditions from developing. Materials include, but are not limited to: flammable gases, vapors or liquids; combustible dust; and ignitable fibers or filings.

Alerting Techniques: The following alerting techniques are used to warn and protect employees from electrical shock hazards, burns, or failure of electric equipment parts.

Safety Signs and Tags: Safety signs, safety symbols, or accident prevention tags are to be used where necessary to warn employees about electrical hazards which may endanger them. Such signs and tags shall meet the requirements of ANSI Z535, *Series of Standards for Safety Signs and Tags*.

Barricades: are used in conjunction with safety signs where necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit parts. Conductive barricades may not be used where they might cause an electrical contact hazard. Barricades shall be placed no closer than the limited approach boundary.

Attendants: If signs and barricades do not provide sufficient warning from hazards, an attendant is to be stationed to warn and protect employees.

Job Briefing

Before starting each work-task involving potential exposure to an electrical hazard, supervisors must discuss all hazards associated with the task with all involved employees. At a minimum, the discussion should include the following subjects:

- Electrical hazards associated with the work task
- Procedures that must be followed when executing the work task
- Any special precautions that are required by the working conditions
- Where and how to remove the energy source
- Emergency response and emergency communications
- Required PPE
- Other work in the immediate physical area
- Other work associated with the same electrical circuits or equipment

Additional job briefings shall be held if changes that might affect the safety of employees occur during the work.

If the work task is a repetitive task that is performed several times during the day, a single job briefing held before the employee performs the task for the first time is satisfactory. A brief discussion shall be satisfactory if the work involved is routine and if the employee is qualified for the task. A more extensive discussion shall be conducted if either of the following apply:

- The work is complicated or particularly hazardous.
- The employee cannot be expected to recognize and avoid the hazards involved in the job.

Use of Equipment

Portable electrical equipment applies to the use of cord-and-plug connected equipment and flexible cord sets (extension cords).

Handling

Portable equipment shall be handled in a manner which will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment.

Flexible cords are not to be fastened with staples or otherwise hung in such a fashion as to damage the outer jacket or insulation.

Visual inspection

Portable cord-and-plug connected equipment and flexible cord sets (extension cords) shall 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.

When defects or evidence of damage which might expose employees to injury are detected, the defective or damaged item shall be removed from service and no person shall use it until it is repaired and tested to ensure it is safe for use.

Grounding-type equipment

- Flexible cords used with grounding-type equipment shall contain an equipment grounding conductor. Other protective measures include double insulation or ground-fault circuit-interrupters (GFCIs).
- Employees shall be provided with GFCI protection where required by applicable state, federal, or local codes and standards.
- GFCI protection shall be provided when an employee is outdoors and operating or using cord- and plug-connected equipment supplied by 125-volt, 15-, 20-, or 30-amp circuits. For equipment supplied by other voltages and amps an assured equipment grounding conductor program shall be implemented to verify the integrity of the grounding conductor of cord sets and cord-and-plug connected equipment.
- Attachment plugs and receptacles may not be connected or altered in any manner which would prevent proper continuity of the equipment grounding conductor at the point where plugs are attached to receptacles. 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.
- Adapters which interrupt the continuity of the equipment grounding connection may not be used.

Conductive work locations

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.

Connecting attachment plugs

Employees hands shall not be wet 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, (if, for example, a cord connector is wet from being immersed in water) the energized plug and receptacle connections must be handled only with insulating protective equipment.

Locking-type connectors shall be properly locked into connector.

Electric Power and Lighting Circuits

Routine Opening and Closing of Circuits

Load rated switches, circuit breakers, or other devices specifically designed as disconnecting means shall be used for the opening, reversing, or closing of circuits under load conditions. Cable connectors not of the load-break type, fuses, terminal lugs, and cable splice connections may not be used for opening, reversing, or closing circuits under load conditions except in an emergency.

Reclosing Circuits after Protective Device Operation

After a circuit is de-energized by a circuit protective device, the circuit may not be manually re-energized until it has been determined that the equipment and circuit can be safely energized. The repetitive manual reclosing of circuit breakers or re-energizing circuits through replaced fuses is prohibited.

When it can be determined from the design of the circuit and overcurrent devices involved that the automatic operation of a device was caused by an overload rather than a fault condition, no examination of the circuit or connected equipment is needed before the circuit is re-energized.

Overcurrent Protection Modification

Overcurrent protection of circuits and conductors may not be modified, even on a temporary basis.

Test Equipment and Instruments

Use

Only qualified persons may perform testing, troubleshooting, and voltage measuring within the limited approach boundary of energized electrical conductors or circuit parts operating at 50 volts or more or where an electrical hazard exists. Employees must be trained to understand that when they are performing testing, they are exposed to shock and electrocution hazards. Each qualified person must be trained to understand how to operate every meter that he or she could be expected to use and to interpret its readings.

When test instruments are used for testing the absence of voltage on conductors or circuit parts operating at 50 volts or more, the operation of the test instrument shall be verified before and after the test is performed. An indication of zero volts might mean that no voltage is present when the test is performed or that the instrument has failed.

Visual Inspections

Test instruments and equipment including all associated test leads, cables, power cords, probes and connectors shall be visually inspected for external defects and damage before the equipment is used. If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service, tagged out of service and no employee may use it until repairs and tests necessary to render the equipment safe have been made.

Rating of Equipment

Test instruments, equipment, and their accessories shall be rated for the circuits and equipment to which they will be connected and designed for the environment in which they will be used.

Personal Protective Equipment

Use of PPE

- Employees working in areas where there are potential electrical hazards shall be provided with and shall use electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.
- Protective equipment shall be maintained in a safe, reliable condition, and periodically inspected or tested.
- If the insulating capability of protective equipment may be subject to damage during use, the insulating material shall be protected by covering with leather or other appropriate materials.
- Nonconductive head protection shall be worn whenever there is danger of head injury from shock or burn due to contact with exposed energized parts.
- Protective equipment for the eyes or face shall be worn whenever there is danger of injury to the eyes or face from arcs, flashes or flying objects resulting from an explosion.

General protective equipment and tools

- Insulated tools or handling equipment shall be used by employees working near exposed energized conductors or circuit parts if the tools or handling equipment might contact such conductors or parts.
- If the insulating capability of insulated tools or handling equipment is subject to damage, the insulating material shall be protected.
- Protective shields, protective barriers, or insulating materials must be used to protect each employee from shock, burns, or other electrically related injuries while employees are working near exposed energized parts which might be accidentally contacted or where dangerous electric heating or arcing might occur.

When normally enclosed live parts are exposed for maintenance or repair, they are to be guarded to protect unqualified persons from contact with the live parts.

PPE while working on energized parts

Employees working in the restricted approach boundary must wear personal protective equipment for protection against electrical shock hazards. Also, employees shall wear arc-rated clothing while in the arc flash boundary whenever there is possible exposure to an electric arc flash above the threshold incident energy level for a second degree burn (1.2 cal/cm²). All parts of the body inside the arc flash boundary shall be protected.

Once the hazard/risk category has been identified from NFPA 70E tables 130.7(C)(15)(a) and 130.7(C)(15)(b), table 130.7(C)(16) shall be used to determine the required PPE for the task.

Arc-related apparel and under layers

- Arc-rated apparel shall be visually inspected before each use. Arc-rated apparel that is contaminated or damaged shall not be used. Protective items that become contaminated with grease, oil, flammable liquids, or combustible liquids shall not be used.
- The garment manufacturer's instructions for care and maintenance of arc-rated apparel shall be followed.

- Arc-rated apparel shall be stored in a manner that prevents physical damage; damage from moisture, dust, or other deteriorating agents; or contamination from flammable or combustible materials.
- When arc-rated apparel is worn to protect an employee during energized work, it shall cover all ignitable clothing and allow for movement and visibility.
- Non-melting, flammable garments (i.e. cotton, wool, rayon, silk, or blends of these materials) must be used as under layers beneath arc-rated apparel.
- Fibers that can melt such as acetate, nylon, polyester, polypropylene, and spandex shall not be permitted in fabric worn by employees as a part of their daily uniforms or in under layers next to the skin. (An incidental amount of elastic used on non-melting fabric underwear or sock shall be permitted).
- When arc-rated clothing is repaired, the same arc-rated materials used to manufacture the clothing shall be used to provide repairs.
- Arc-rated garments worn as outer layers over arc-rated apparel (i.e. jackets or rainwear) must also be made from arc-rated material.

Head, face, neck and chin protection: head area

- Employees shall wear nonconductive head protection whenever there is a danger of a head injury from shock or burns due to contact with energized electrical conductors or circuit parts or from flying objects resulting from an electrical explosion.
- Employees shall wear nonconductive protection for the face, neck, and chin whenever there is danger of injury from exposure to electric arcs or flashes or from flying objects resulting from an electrical explosion.
- An arc-rated balaclava (sock hood) shall be used with an arc-rated face shield when the back of the head is within arc flash boundary.
- An arc-rated hood shall be permitted to be used instead of an arc-rated face shield and balaclava. When exterior air is supplied into the hood, the hoses and pump housing shall be either covered by arc-rated materials or constructed of non-melting and nonflammable materials.
- Employees shall wear protective equipment for the eyes and face whenever there is a danger of injury from electric arcs, flashes, or from flying objects resulting from an electrical explosion.
- Face shields shall have an arc rating suitable for the arc flash exposure.
- Face shields with a wrap-around guarding to protect the face, chin, forehead, ears, and neck area shall be used.
- Eye protection (ANSI approved safety glasses with side shields or goggles) shall always be worn under face shield.
- Additional illumination may be needed when using tinted face shields as protection during electrical work.

Hand and arm protection

- Employees shall wear rubber insulating gloves with leather protectors where there is danger of hand injury from electric shock due to contact with energized electrical conductors or circuit parts.
- Rubber insulating gloves shall be rated for the voltage for which gloves will be exposed.
- Hand and arm protection shall be worn where there is possible exposure to arc flash burn. Use NFPA PPE tables to select appropriate apparel.

Foot protection

Heavy-duty leather work shoes shall be worn in all exposures greater than 4 cal/cm².

Hearing protection

Employees shall wear ear plugs that insert into the canal (ear canal inserts) to protect from hearing loss whenever working within the arc flash boundary.

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.
- 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.
- Where the insulating capability of protective equipment is subject to damage during use, the insulating material shall be protected by an outer covering of leather or other appropriate material (i.e. Gloves).
- Rubber insulating equipment must be stored in an area protected from light, temperature extremes, excessive humidity, ozone, and other substances and conditions that may cause damage.
- An air test must be performed on rubber insulating gloves before each use. The test method to be used is described in ASTM F 496, Specification for In-Service Care of Insulating Gloves and Sleeves. Fill the glove with air, either manually or by an inflator, and then checked for leakage. The leakage is detected by either listening for escaping air or holding the glove against the tester's cheek to feel air releasing.

Insulating Equipment	Test Intervals	Type of Equipment	When to Test
Rubber insulating gloves	Before first issue and every 6 months thereafter ¹	Rubber insulating sleeves	Before first issue and every 12 months thereafter ¹
Rubber insulating covers	Upon indication that the insulating value is suspect	Rubber insulating blankets	Before first issue and every 12 months thereafter ¹
Rubber insulating line hose	Upon indication that the insulating value is suspect		

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

Insulated tools and equipment

- Insulated tools shall be rated for the voltages on which they are used.
- Insulated tools and equipment shall be inspected prior to each use. The inspection shall look for damage to the insulation or damage that may limit the tool from performing its intended function or could increase the potential for an incident.

Fuse handling equipment

Insulated for the circuit voltage, shall be used to remove or install fuses when the fuse terminals are energized.

Ropes and handlines

Used near exposed energized parts shall be nonconductive.

Contract Employees

The NC A&T representative shall inform contract employers of known electrical hazards and provide information about the work that the contractor needs to make an assessment. Safety

programs used by contractors must meet or exceed all applicable guidelines of the NC A&T Electrical Safety Program. Contractors may be required to submit copies of their program to the NC A&T representative associated with the work. After the work is complete, contractors must notify NC A&T of any hazards created by the work. There shall be a documented meeting between the host employer and the contract employer. Documentation should include a thorough description of the items discussed and strategies that will be implemented on how the hazard(s) will be mitigated.

Training

Each employee who is or might be exposed to an elevated risk of injury by exposure to an electrical hazard must be trained to understand the specific hazards to which he or she might be exposed. To increase understanding, training should include the following:

- What electrical hazards are present in the workplace
- How each electrical hazard affects body tissues
- How to determine the degree of each hazard
- How to avoid exposure to each hazard
- How to minimize risk by body position
- What PPE is needed for work assignments
- How to select and inspect PPE
- What employer-provided procedures, including specific work practices, are in place
- How to perform a hazard identification and risk assessment analysis
- How to determine limited, restricted, and prohibited approach boundaries
- How to interpret information on equipment labels
- How increased duration of exposure to an electrical hazard results in higher frequency of injuries

Supervisors or the designated employee in charge of administering Electrical Safety training must turn in a copy of all training documents (content) and roster sheets to the Department of Environment, Health, and Safety for recordkeeping.

Type of training

Training shall be classroom or on-the-job type or a combination of the two. The level of training provided is dependent on whether the employee is classified as a “qualified worker” or “unqualified worker.”

Emergency procedures

Employees exposed to shock hazards and those employees responsible for acting in case of emergency shall be trained in methods of release of victims from contact with exposed energized electrical conductors or circuit parts. Employees must be trained to know that the first action in responding to an electrical contact incident must be to remove the source of the electricity and the second action is to request emergency assistance. Employees also must know how to request assistance.

If an employee's job duties include response to medical emergencies associated with a shock or arc flash accident, the employee must be trained to perform cardiopulmonary resuscitation (CPR), properly use an automatic external defibrillator (AED), and administer first aid. CPR and first aid must be certified by the employer annually.

Qualified worker

For a person to be considered qualified, the employee must receive general electrical safety training as stated above as well as training listed in this section:

- Skills and techniques necessary to distinguish exposed energized electrical parts from other parts of electrical equipment
- Skills and techniques necessary to determine the nominal voltage of exposed energized electrical parts
- Approach distances and the corresponding voltages to which the qualified person will be exposed
- Decision-making process necessary to determine the degree and extent of the hazard and job planning to perform the task safely
- In the selection of PPE and tools, including a dry run practice to ensure PPE does not limit the person's dexterity or vision.
- A person can be considered qualified with respect to certain equipment and methods but still unqualified for others.
- Tasks performed less often than once per year shall require retraining before the performance of the work practices involved.
- In the selection of appropriate voltage detector and shall demonstrate how to use the device to verify the absence of voltage. The employee should also understand the limitations of each detector.
- Employees undergoing training to become a qualified worker are considered qualified if he or she is under the direct supervision of a qualified worker.
- The employer shall determine, through regular supervision or through inspections conducted on at least an annual basis that each employee is complying with safety-related work practices.
- Professional licensing or certification does not ensure that an employee is qualified unless the training fulfills the requirements of qualified training specified in this policy.

Unqualified worker

An unqualified worker shall be trained in the inherent hazards of electricity and any related work practices that are necessary for their safety.

Retraining

An employee shall receive additional training (or retraining) under any of the following conditions:

- If the supervision or annual inspections indicate that the employee is not complying with the safety-related work practices
- If new technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that different from those that the employee would normally use
- If he or she must use safety-related work practices that are not normally used during his or her regular job duties
- If there are changes to the Electrical Safety Program

Retraining shall be performed at intervals not to exceed 3 years.