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## **ELECTRICAL WORK PRACTICES**

### **PURPOSE**

- To establish proper training and work practices to ensure electrical work is performed in a safe manner per Drake University and OSHA standards.
- Minimize incidents and exposure to electrical energy by unqualified persons.
- Ensure that all Drake University facilities are maintained using high electrical standards

### **SCOPE**

This procedure applies to all Drake University locations where employees may be exposed to electrically energized equipment and /or those parts that may be energized and all electrical equipment used in maintenance and/or construction activities.

### **RESPONSIBILITIES**

Facility Services bears overall responsibility for the Electrical Safety Program and must ensure that the proper training status has been met for Authorized and Qualified levels. Facility Services in conjunction with Environmental Health and Safety (EHS) is responsible for identifying a competent person to manage the requirements of the electrical safety program.

The designated Competent Person is responsible for implementing and maintaining the requirements of the Electrical Safety Program.

All employees are responsible for complying with the requirements of this procedure.

Under this program, our employees receive instructions in the purpose and use of energy control procedures, as well as the other required elements of the Control of Hazardous Energy standard. This instruction includes the de-energizing of equipment, applying locks and tags, verifying de-energization, and equipment re-energizing.

## **DEFINITIONS**

**Electrical enclosure:** any enclosure that may contain uninsulated electrical connections, such as switchgears, starters, disconnects, junction boxes, and control panels.

**Authorized employee:** as defined in CFR 1901.147 (b) is a person who locks out or tags out Machines or equipment in order to perform servicing or maintenance on that machine or equipment.

**Cord Sets:** any portable electrical cord used for extension or remote power, typically made up of a plug, wiring, and receptacle or the cord and plugs for all equipment and tools used for maintenance or construction activities. Pig-Tail, GFCI extensions, extension cords, and the cords for portable tools are considered cord sets by definition.

**Portable Receptacles:** any receptacle that is not wired within rigid conduit and secured to a building structure, ceiling, or other permanently secured equipment.

**Portable Equipment:** electrically powered equipment that is not assigned to a designated single position for use at the facility (i.e. – wheeled conveyors, maintenance tools such as drills, welders, saws).

**Qualified person (electrical):** as defined in CFR 1910.332(b)(3)& can be classified into two levels as follows:

**Level 1-** Those who work on or near exposed energized parts.

**Level 2-** Those who work on energized equipment and involving either direct contact or contact by means of tools or materials.

## **ROLE RESPONSIBILITIES**

“**Competent Person**” is the employee designated by site management that is responsible for:

- monitoring of electrical work practices at the site,
- selection/qualification of contractors who perform electrical work at the site,
- management of a system to achieve and maintain appropriate qualifications for electrical workers employed by Drake University,
- monitoring of practices covered by the Energized Electrical Work Procedure

“**Authorized employee**” is restricted to the following:

- Lockout/tagout for equipment with local disconnecting means only, and
- Must not be exposed to energized electrical parts.

## “Qualified person”

- **Level 1** can, on systems below 600 Volts:
  1. Repair or replace existing installed system components, i.e. motor starters, light fixtures receptacles and switches
  2. Trouble shoot and replace/repair wiring
  3. Change live fuses with prior authorization.
  4. Any other work consistent with training and knowledge level that has been approved by the Electrical Supervisor or EHS prior to work commencing.
  
- **Level 2** can:
  1. Install or Modify systems
  2. Install starters and motor controls for equipment
  3. Install new receptacles, light fixtures, switches etc.
  4. Install new raceways and wire
  5. Install PLC components if trained
  6. Change Fuses
  7. Install Circuit breakers in an energized panel
  8. Attach wires to existing breakers in a live panel
  9. Test and inspect electrical components over 600 volts
  10. Any other work consistent with training and knowledge level that has been approved by the Electrical Supervisor and EHS prior to work commencing.
  11. All items allowed by level 1

## **PROCEDURE**

### **INSTALLATION AND EQUIPMENT**

#### **WIRING AND EQUIPMENT INSTALLATION**

All electrical installations shall comply with the requirements of all the national and local codes as well as OSHA and the requirements of this procedure. In the event of discrepancies between the requirements of this procedure and specific statutory requirements, the more stringent requirements shall be followed.

All electrical equipment used shall be designed and manufactured in accordance with the U.L. standards.

### **ACCESSIBILITY OF ELECTRICAL SYSTEMS**

#### **600 VOLTS, NOMINAL, OR LESS**

There shall be no less than 3 feet cleared working space in the front of any switchboards, fuse panels or motor control centers. The working space required may not be used for storage at any time.

When normally enclosed live parts are exposed for inspection or servicing, the working space shall be suitably guarded reducing the risk of exposure by unauthorized employees, visitors, and/or guests. An approach boundary in accordance with NFPA 70E Table 130.4(D)(a) *Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems* is required to prohibit access to live equipment for all unauthorized employees, visitors and/or guests.

All live electrical equipment operating at 50 volts or more shall be guarded against accidental contact by approved cabinets or by locating the equipment in a room, a vault, or other similar enclosures that can be accessible only to qualified personnel.

All rooms, vaults, or other similar enclosures shall be marked “Danger High Voltage - Unauthorized Personnel – Keep Out” or by any other means that states that access is only granted to authorized personnel. All electrical cabinets that are opened by handle or other non-secured means (bolts are considered a secured means) must be marked “Warning -Arc Flash and Shock Hazard – Appropriate PPE Required.”

In the event whereby unauthorized personnel may need to enter a room, vault or other similar enclosure where live exposed electrical components are present, that individual MUST be accompanied by an authorized person at all times.

Illumination shall be provided for all working spaces for service equipment, switchboards, panel boards, and motor control centers installed indoors.

#### **OVER 600 VOLTS, NOMINAL**

All electrical installations in a vault, room, closet or in an area surrounded by a wall, screen or fence greater than 600 volts nominal shall be marked “Danger High Voltage – Unauthorized Personnel – Keep Out” or by any other means which states that access is only granted to authorized personnel.

Access to any vault, room, closet or areas surrounded by a wall, screen or fence which has components of 600 volts nominal or greater must be controlled by lock and key and are considered accessible to qualified personnel only.

In the event whereby unauthorized personnel may need to enter a room, vault or other similar enclosure where live exposed electrical components are present, that individual MUST be accompanied by an authorized person at all times.

Electrical installations that are open to unqualified persons shall be made with metal-enclosed equipment or shall be enclosed in a vault or in an area that is controlled by a lock. All installations that are open to unqualified persons shall be marked with appropriate cautions signs stating authorized personnel only.

Illumination shall be provided for all working spaces for service equipment, switchboards, panel boards, and motor control centers installed indoors.

## **WORKING ON OR NEAR ELECTRICAL COMPONENTS**

### **DE-ENERGIZED PARTS / EQUIPMENT**

When a qualified employee works on an electrical circuit in the de-energized state the applicable procedure for Lock out / Tag out shall be used.

Only qualified employees (Qualified Level 1 or Qualified Level 2) are allowed to work on electrical equipment or electrical systems. Authorized employees are only allowed to perform Lockout / Tagout functions and are restricted from access to energized enclosures.

When a qualified employee (Qualified Level 1 or Qualified Level 2) works on an electrical circuit in the de-energized state, the applicable procedure for Lockout/Tagout shall be used. The Energized Electrical Work Permit is not required when work is being conducted on de-energized equipment or in electrical enclosures that are de-energized and have the supply power leads (power supply feeding the electrical disconnect or enclosure) and all foreign power properly guarded. All conductors and parts of electrical equipment that have been de-energized but have not been locked out or tagged out shall be treated as energized parts.

Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, and metal head gear) shall not be worn if they might contact exposed energized parts.

Only ladders with non-conductive side-rails shall be used where they may contact exposed energized parts.

After a circuit is de-energized by a circuit protective device, the circuit shall not be re-energized until it has been determined the equipment and circuit can be safely energized. The repetitive re-closing of circuit breakers or reenergizing circuits through replacing fuses is prohibited.

Electrical test instruments and equipment shall be factory tested per the factory test requirements, and all associated test leads, cables, power cord, 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 with a DO NOT OPERATE tag and shall not be used until necessary repairs and tests to render the equipment safe have been made.

### ENERGIZED PARTS / EQUIPMENT

Any circuits and/or equipment to be worked on shall be disconnected from all electrical energy sources and locked out/tagged out unless the employee/manager can demonstrate that de-energizing introduces additional or increase hazards, or is infeasible due to equipment design or operational limitations as followed (greater than 50 volts):

- Examples of increased or additional hazards include deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment, or removal of illumination for an area.
- Examples of work that may be performed on or near energized circuit parts because of infeasibility due to equipment design or operational limitations include testing of electrical circuits that can only be performed with the circuit energized and work on circuits that form an integral part of continuous process that would otherwise need to be completely shut down in order to permit work.
- 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 electrical arcs.

Only qualified employees specified on the Energized Electrical Work Permit (must be Qualified Level 1 or Qualified Level 2) shall be allowed entry to enclosures containing exposed live wires.

Prior to conducting work on an energized piece of equipment or exposed energized electrical components (greater than 50 volts), an Energized Electrical Work Permit is required. The Energized Electrical Work Permit can be found in Appendix 4 and must have all required fields completed, along with approval from either the Electrical Supervisor or EHS before work can begin.

The justification for working on exposed energized electrical equipment shall be documented on the Energized Electrical Work Permit and must have the Electrical Supervisor or EHS approval.

If the electrical panel and enclosure is de-energized, but there is no guarding (finger-safe guards) or shields for the supply (power supply feeding the electrical disconnect or enclosure) and / or guarding around foreign power components, the activity shall be treated as working on live equipment requiring the use of an Energized Electrical Work Permit. All conductors and parts of electrical equipment that have been de-energized but have not been locked out or tagged out shall be treated as energized parts.

Circuit Breaker operation and Fuse Switch operations are exempt from the Energized Electrical Work Permitting program when all electrical components are guarded and covered.

Qualified employees (Level 1 or Qualified Level 2) shall not enter spaces containing exposed live parts, unless illumination is provided that enables the employees to perform the work safely. Additionally, qualified employees shall not be within 4 feet of any exposed live parts without the proper Arc Flash and Electrocution PPE required (See PPE below for proper PPE)

Only ladders with non-conductive side rails shall be used where they may come in contact exposed energized parts.

When normally enclosed live parts are exposed for inspection or servicing, the working space shall be suitably guarded reducing the risk of exposure by unauthorized employees, visitors, and/or guests. An approach boundary in accordance with NFPA 70E Table 130.4(D)(a) *Approach Boundaries to Energized Electrical Conductors or Circuit Parts for Shock Protection for Alternating-Current Systems* is required to prohibit access to live equipment for all unauthorized employees, visitors and/or guests.

When a non-qualified employee is working near an overhead line, they must maintain a minimum distance of 10 feet between the exposed overhead equipment (ladder, scissor lift, bucket lift, etc.) or power line and their self or any conductive object they may contact.

## **PPE / TOOLS REQUIREMENTS FOR ELECTRICAL WORK**

There are two categories for assessment with regards to PPE requirements when working on or in live electrical equipment or components. Electrocution and Arc Flash are two separate hazards associated with working on electrical equipment, each requiring unique personal protection to protect operators from the potential hazards.

### **ELECTROCUTION PPE / TOOLS REQUIREMENTS**

Voltage rated gloves, rated and tested for the maximum line-to-line voltage upon which work will be done, are required for all work on energized parts, all work in electrical panels that have unguarded energized supply power feeds (no finger safe guards), all work in electrical panels that have unguarded foreign power sources (no finger safe guards), and all voltage testing of energized components.

Voltage rated tools, rated and tested for the maximum line-to-line voltage upon which work will be done, are required to be used on energized equipment. Voltage meters must have a Category rating of III or IV @ 600 V. All category I and II meters are not allowed to be used when performing electrical work. All ratings are defined by the International Electrotechnical Commission (IEC).

### **ARC FLASH PPE REQUIREMENTS**

#### **50 Volts to 240 Volts**

All work on energized equipment, at or below 240 volts (down to 50 volts), including electrical panels where supply feed of 240 volts or lower is not de-energized or guarded, activities where foreign power is present inside an electrical panel at or below 240 volts unguarded, and / or when removing the bolts of a cover requires protection of a hazard class 1. Hazard class 1 PPE are:

- Long Pants (made of natural fibers – denim cotton blue jeans or treated fire resistant material)

**AND**

- Fire Resistance long sleeved shirt or Arc Flash Suit jacket (4 cal/cm<sup>2</sup> or greater)
- NOTE: Fire resistance materials are fibers such as flame-retardant treated cotton, meta-aramid, para-aramid, and poly-benzimidazole (PBI) fibers.

**OR**

- Fire Resistant Coveralls with an arc flash rating of 4 cal/cm<sup>2</sup> or greater.

Circuit breaker or fuse switch operations with the covers off, and the opening of hinged covers to expose bare wire on energized equipment requires protection for a Class 0 hazard. Hazard Class 0 PPE are:

- Long Sleeved Natural Fiber Shirt (i.e. untreated cotton, wool, rayon, silk, or denim)

**AND**

- Long Legged Natural Fiber Pants (i.e. untreated cotton, wool, rayon, silk or denim)

Circuit Breaker and/or Fuse Switch operations, when all electrical components are guarded and covered, are exempt from the Energized Electrical Work Permitting program when resetting or replacing fuses and / or resetting breakers.

### 241 Volts to 480 Volts

All work on energized equipment, between 241 volts to 480 volts, including electrical panels where supply feed of 240 volts to 480 volts is not de-energized or guarded, and / or where foreign power is present inside an electrical panel 241 volts to 480 volts unguarded requires protection of a hazard class 2. Hazard class 2 PPE are:

- Arc Flash Suit (8 Cal/cm<sup>2</sup>) Pants and Jacket
- Hard Hat with Face Shield (2 options)
  - Hard Hat with a Fire Resistant Face Shield (minimum 8 Cal/cm<sup>2</sup>) and Arc Flash Suit Hood pulled over head and secured

**OR**

- Hard Hat with a Fire Resistant Face Shield (minimum 8 Cal/cm<sup>2</sup>), with wrap around guarding to protect the face, forehead, ears, and neck
- Hearing Protection
- Safety Glasses or Goggles
- Leather Gloves (leather protectors worn externally over the rubber gloves)
- Leather Work Shoes

### 481 Volts or Higher

All work on energized equipment, over 480 volts requires:

- A total clothing system consisting of arc-rated shirt and pants and/or arc-rated coveralls and/or arc flash coat and pants (clothing system minimum arc rating of 40 Cal/cm<sup>2</sup>)
- Hard Hat with Face Shield (2 options)
  - Hard Hat with a Fire Resistant Face Shield (minimum 40 Cal/cm<sup>2</sup>) and Arc Flash Suit Hood pulled over head and secured



**OR**

- Hard Hat with a Fire Resistant Face Shield (minimum 40 Cal/cm<sup>2</sup>), with wrap around guarding to protect the face, forehead, ears, and neck
- Hearing Protection
- Safety Glasses or Goggles
- Insulating Rubber gloves rated for voltage worked on
- Leather Gloves (leather protectors worn externally over the rubber gloves)
- Leather Work Shoes

## **MAINTENANCE AND INSPECTION**

### PERSONAL PROTECTIVE EQUIPMENT

Fire resistant apparel (including Arc Flash Suits) shall be visually inspected before each use. Work clothes or flash suits that are contaminated, or damaged to the extent their protective qualities are impaired, shall not be used. Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be use.

Voltage rated gloves shall have the required inflation test performed prior to each use. If gloves do not hold the inflation, the defective or damaged gloves shall be removed from service. Voltage rated gloves shall be inspected by the manufacturer or approved testing laboratory every 6 months or taken out of service 6 months from the first use of the gloves.

### ELECTRICAL TESTING EQUIPMENT / TOOLS

Electrical test instruments and equipment and all associated test leads, cables, power cord, 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, and no one may use it until necessary repairs and tests which render the equipment safe have been made.

Insulation on voltage rated tools shall be visually inspected prior to use on energized equipment to verify insulation is not torn, damaged, or removed.

### ELECTRICAL COMPONENTS USED FOR CONSTRUCTION

Electrical protection of employees for construction work is obtained through ensuring electrical power tools, extension cords, and cord and plug-connected equipment are in proper working condition. This is accomplished through use of either ground-fault circuit interrupters or an assured equipment grounding conductor program to protect employees during construction work.

Drake University requires all extension cords, portable power tools, and cord and plug-connected equipment used in construction activities to be tested for ground continuity, if possible. All required tests shall be performed:

1. Before first use;
2. Before equipment is returned to service following any repairs;

3. Before equipment is used after any incident which can be reasonably suspected to have caused damage (i.e. when a cord set is run over).
4. At intervals not to exceed 3 months, except those cord sets, extension cord receptacles, and pig-tail GFCI receptacles which are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months (i.e. – self retracting extension cord systems mounted from ceiling).

Drake University shall not make available or permit the use by employees of any equipment that has not met these four requirements.

Tests performed as required above shall be recorded. This test record shall identify each cord set, and cord-and plug-connected equipment that passed the test and shall indicate the last date it was tested or the interval for which it was tested. This record shall be kept by means of logs, color-coding, or other effective means and shall be maintained until replaced by a more current record. The records shall be made available on the jobsite for inspection by OSHA and any affected employee.

Drake University will utilize the color-code method, recording the date testing has taken place. All but fixed equipment will be tested on a quarterly basis and marked. Cord sets, extension cord receptacles, and pig-tail GFCI receptacles which are fixed and not exposed to damage shall be tested at intervals not exceeding 6 months (i.e. – self retracting extension cord systems mounted from shop ceiling).

**COLOR CODING CORDS SETS AND CORD-AND PLUG-CONNECTED EQUIPMENT**

One of the companies approved methods of acceptable record keeping is found in the following table lists a color code that is in wide use by electricians and contractors. A distinctive colored identifier is placed on one or both ends of cords and cord- and plug-connected equipment to denote the month that the tests were performed.

Assured Equipment Grounding Conductor Program Color Code			
Month #	Month Tested	Color of tape(s) to apply to cord	
1	January	WHITE	
2	February	<b>White +</b>	<b>Yellow</b>
3	March	<b>White +</b>	<b>Blue</b>
4	April	GREEN	
5	May	<b>Green +</b>	<b>Yellow</b>
6	June	<b>Green +</b>	<b>Blue</b>
7	July	RED	
8	August	<b>Red +</b>	<b>Yellow</b>
9	September	<b>Red +</b>	<b>Blue</b>
10	October	ORANGE	
11	November	<b>Orange +</b>	<b>Yellow</b>
12	December	<b>Orange +</b>	<b>Blue</b>

Two wraps of this primary color will indicate even years.  
 One wrap of this primary color will indicate odd years.

At a minimum, Drake University requires that all electrical devices applicable in the assured grounding program be marked with the appropriate primary color identifying the quarter of the inspection. Quarterly Inspection documentation can be conducted by the secondary tapes (as identified in the chart above) or by documenting the inspections on the appropriate monthly inspection forms developed by the university.

## **TRAINING**

Prior to performing work associated with electricity (up to, and including energy isolation or Lockout / Tagout of electrical disconnects and/or plug and cord equipment) all employees must receive the required training on electrical safety as specified in the following procedure. This training is designed to ensure that all individuals required to perform such work have received the proper training on the hazards associated with electricity. The following criteria are required for working on or near electrical equipment:

The training will be provided by a qualified instructor, knowledgeable in this procedure and where applicable, regulatory requirements. A written examination and/or sign off sheet will be part of the training verification (see attached example of an examination in Appendix 2).

Every employee who faces the risk of electric shock from working on or near energized or de-energized electrical sources receives training in electrical related safety work practices pertaining to the individual's job assignment.

The goal of our electrical safety training program is to ensure that all employees understand the hazards associated with electric energy and that they are capable of performing the necessary steps to protect themselves and their coworkers.

Our electrical training program covers these basic elements:

- Lockout and tagging of conductors and parts of electrical equipment.
- Safe procedures for de-energizing circuits and equipment.
- Verification that the equipment has been de-energized.
- Procedures for re-energizing the circuits or equipment.
- Other electrically related information that is necessary for employee safety.

All non-qualified employees shall receive training in the general hazard of electricity, plant voltages, electric current, arcing, grounding, safe clearances, and the provisions of this procedure relating to a non-qualified employee.

All qualified employees shall receive training in the provisions of this procedure, skill and techniques necessary to distinguish exposed live parts, how to determine the nominal voltage of exposed live parts, the clearance distances, and the safety related work practices required to perform their assignment. Qualified individuals working on energized equipment must be trained on the procedure for working circuits hot, and understand the limitations of their training which may or may not include: discharging high voltage cables and capacitors, and the proper lock out of substations, MCCs feeders, capacitors, and high voltage equipment.

## **MINIMUM LEVELS OF TRAINING**

### **Authorized employee**

1. Complete lockout/tagout training.
2. Receive specific training on Machine specific procedures (JSA, LOTO and/or SOP).  
This will satisfy the following 3 OSHA requirements:
  - Recognition of applicable Hazardous energy sources
  - Type and magnitude of energy available in the work place
  - Methods and means necessary for energy isolation and control

### **Qualified Level 1**

1. Complete requirements for Authorized employee.
2. Complete general electrical principles and practices training including:
  - Proper operation and maintenance of testing equipment
  - Identification of electrical circuit components
  - Personal electrical safety and PPE requirements
  - Limitations of service level.
4. Basic training can be presented in multiple formats, (video, PowerPoint, Classroom, CBT) with written testing follow up.
  - This training will satisfy the OSHA requirements of:
    - a. Skills and techniques necessary to distinguish exposed live parts from other parts of electrical equipment.
    - b. Skills and techniques necessary to determine the nominal voltage of exposed live parts.
    - c. The clearance distances specified in section 1910.333(c) and the voltages to which the person will be exposed.

### **Qualified Level 2**

Level 2 individuals will be trained electricians with current and valid state licenses.

## **EVALUATION**

Appendix 1 can be used to perform an annual written gap analysis or program evaluation.

**APPENDIX 1**

**Electrical Safety Checklist**

	<b>Yes</b>	<b>No</b>
1. Have qualified electrical workers been designated?		
2. Has training for non-qualified and qualified workers been conducted?		
3. Are the available tools adequate for the work		
4. Does the location have a designated Competent Person responsible for implementation and compliance with the Electrical Safety Program.		
5. Does the location have the required Arc. Flash and Electrocutation protection equipment for the available power on site if there is a Level 2 electrician?		
6. Does the location have extension cords, portable power tools and equipment identified with the appropriate color code specified by the chart.		
7. Does the location have all the electrical cabinets supplied with opening handles labeled where energized equipment is present (cabinets with screws or bolts holding the door closed can be exempt from labeling)		

**Conducted by:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Actions Required**

**Responsibilities**

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

## APPENDIX 2

### Electrical Safety – Working On or Around Examination

1. Only qualified workers are allowed entry to enclosures containing exposed live parts.	<b>T</b>	<b>F</b>
2. A non-qualified worker may work within 10 foot of any conductive object.	<b>T</b>	<b>F</b>
3. A Lockout/Tagout permit is always required when performing electrical work.	<b>T</b>	<b>F</b>
4. It is acceptable to wear jewelry when working around exposed energized parts.	<b>T</b>	<b>F</b>
5. Metal ladders may be used where exposure to energized parts is a potential.	<b>T</b>	<b>F</b>

**Name** \_\_\_\_\_

**Date** \_\_\_\_\_

**Instructor** \_\_\_\_\_

**Score** \_\_\_\_\_

## **Electrical Safety Examination**

1. True
2. False
3. False – A level II qualified person will be trained to work with circuits energized and have proper PPE. Also, basic testing will require power to be on.
4. False - Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, and metal head gear) shall not be worn if they might contact exposed energized parts.
5. False - Only ladders with non-conductive side rails shall be used where they may contact exposed energized parts.

## **Electrical Safety - Assured Grounding Safety Quiz**

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Circle the correct answer(s) for each question.

1. An “Assured Equipment Grounding Program” is
  - a. a scheduled system for testing site electrical tools and extension cords to assure their proper ground, polarity and resistance.
  - b. equipment that serves as a circuit breaker if continuous ground continuity in an electrical tool is not present.
  
2. A Ground Fault Circuit Interrupter (GFCI) is
  - a. a scheduled system for testing site electrical tools and extension cords to assure their proper ground, polarity and resistance.
  - b. equipment that serves as a circuit breaker if continuous ground continuity in an electrical tool is not present.
  
3. A Ground Fault Circuit Interrupter (GFCI) must be used on a worksite:
  - a. when electrical tools and extension cords are used in connection with the process of construction or alteration
  - b. when 120-volt, single-phase, 15-20 ampere receptacle outlets are being used, which are not a part of the permanent wiring of buildings or structures
  - c. both a & b
  - d. none of the above
  
4. Electrical tools and extension cords should be tested for grounding and continuity of the circuitry. . .
  - a. Before first use
  - b. When returned to service following repairs
  - c. At least every three months on a scheduled basis
  - d. All of the above
  
5. TRUE or FALSE - Workers should continually look for defects (deformed or missing pins, insulation damage, and indications of possible internal damage).
  
6. The Assured Grounding two-color coding system identifies:
  - a. The quarter in which the equipment was tested
  - b. The month within the quarter when the last test took place
  - c. Who tested the equipment
  
7. TRUE or FALSE – The first color identifies the quarter in which the equipment was last tested.
  
8. TRUE or FALSE – The second color identifies the month within the quarter when the last test took place.



9. The color-coding system must be maintained as part of the company's written safety program. A log of the items inspected and date of the test must be kept by an authorized person who is competent to recognize electrical hazards.
  - a. True
  - b. False
  
10. TRUE or FALSE – “Double insulated” tools, which are clearly marked and identifiable as a double-insulated tool is exempted from Assured Grounding tests.
  
11. When there are general and subcontractors on a job site, who is responsible for the Assured Grounding or GFCI program?
  - a. Each subcontractor on a job may use his own individual program, but general and sub-contractors alike are responsible for having a program in place –preferable coordinated. (Good generals insist on a coordinated program to avoid mishaps, cross color-coding and to help maintain enforcement. The code colors within a “test period” are often displayed in a visible location by the inspector, for all workers to see.)
  - b. Unless the general provides GFCIs for central power and all portable power stations at jobsite locations, subcontractors must provide their own GFCIs or Assured Grounding program for all temporary power use.
  - c. Both A & B
  - d. None of the above
  
12. TRUE OR FALSE – All new employees and construction workers to the jobsite who use electrical tools should receive training or a review of this assured grounding program.
  
13. TRUE OR FALSE – Drake University requires GFCIs to be used in conjunction with the assured grounding program.

## **Quiz Answer Key**

1. a
2. b
3. c (or both a & b)
4. d
5. True
6. a & b
7. True
8. True
9. True
10. True – but the tools should nevertheless be inspected by workers before each use for cord damage or case damage. They may also be taped for inclusion in the overall program.
11. c
12. True
13. True

## APPENDIX 3

### Specific Tool list for Qualified Electricians

1. Safety equipment
  - Electrically Insulated gloves
  - Blankets
  - Safety Helmets
  - Face shield
  - Arc Flash Suit/Shirts
  - Lock out locks and tags along with any necessary adapters
2. Test equipment
  - Voltage meter **Class III** or higher
  - Amperage meter (inductive clamp on)
  - Non-contact voltage presence tester
3. Voltage Rated hand tools
  - Screwdrivers
  - Linemans
  - Side cutters
  - Strippers
  - Nut drivers
4. Electrician hand tool
  - Basic handtools
  - Conduit bender
  - Wire pulling fish tape
  - Knockout punch or hole saws for conduit sizes
5. Power tools
  - Drill motor and bits
  - Conduit threader

All tools must be maintained in good working order and training on their use must be provided prior to using the tools.

**APPENDIX 4 – ENERGIZED ELECTRICAL WORK PERMIT**

**PART I: TO BE COMPLETED BY THE REQUESTER:**

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 process can be shut-down and de-energized: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Requestor Name: \_\_\_\_\_ Date: \_\_\_\_\_

<b>PART II: COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS <i>DOING</i> THE WORK:</b>	<b>CHECK WHEN COMPLETE</b>
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1. Evidence/details of completing of a job briefing including discussion of any job related hazards: _____ _____	<input type="checkbox"/>
2. Arc Flash and Electrical Shock Barrier installed for only Qualified Personnel to enter with appropriate PPE.	<input type="checkbox"/>
3. Authorized Personnel Only barrier installed for Authorized Personnel Only to enter.	<input type="checkbox"/>
4. Appropriate Arc Flash PPE Available	<input type="checkbox"/>
6. Name of attendant present at the systems emergency stop or disconnect for the equipment being worked on to de-energize the system in the event of an emergency: _____	
7. Do you agree the above described work can be done safely: <input type="checkbox"/> YES <input type="checkbox"/> NO      (If <i>NO</i> , return to requestor)	
_____ Electrically Qualified Person(s) Doing Work (sign)	_____ Attendant (Sign)

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

_____ Electrical Supervisor	_____ Date
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**NOTIFICATION OF THE PREFORMANCE OF WORK WHILE ELECTRICITY ENERGIZED:**

_____ EHS	_____ Date
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