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# **Section I**

## **Introduction**

## Policy

Electricity is used in many different ways at Hilscher-Clarke. Each application has its own combination of hazards that includes the potential of electric shock, fire, and burns. Because Hilscher-Clarke recognizes these potential hazards it has established this plan to reduce or eliminate the dangers associated with the use of electrical energy. Every person on a Hilscher-Clarke work site is exposed to electricity to some extent. This electrical safety program is intended to give those persons who may come in proximity with energized electrical parts in their work activities the minimum knowledge of safety and recommended practices necessary to protect against electrical shock or burns. It also provides hazard awareness information to those who use electrical equipment.

Reading this plan does not qualify anyone to perform electrical work. Guidelines that are beyond the scope of this document must be established at each work area. They will include, as a minimum, the safety concerns outlined in this plan.

All electrical wiring, equipment, and related personal protective equipment (PPE) must comply with ANSI standards, OSHA regulations, and numerous other established safety and engineering standards. This plan is in no way to be construed as a synopsis of all electrical requirements, nor as a substitute for formal study, training, and experience in electrical design, construction, and maintenance.

Electrical accidents are generally caused by:

- Unsafe acts;
- Unsafe conditions; or
- A combination of the two.

Some unsafe electrical equipment and installations can be easily identified by the presence of:

- Faulty insulation;
- Improper grounding;
- Loose connections;
- Defective parts;
- Ground faults in equipment; or
- Unguarded live parts.

Environments containing:

- Flammable vapors;
- Liquids;
- Gases;
- Areas containing corrosive atmospheres;
- Wet & damp locations;

Are recognized unsafe environments affecting electrical safety.

Unsafe acts such as:

- Failure to de-energize electrical equipment when it is being repaired or inspected;
- The intentional use of defective and unsafe tools;
- Use of tools or equipment too close to energized parts;

Are all contributors to electrical hazards.

Hilscher-Clarke Electric Co. has created this safety policy and procedures to provide guidelines for safely working around electrical hazards. It includes provisions for training, general lockout/tagout requirements (*see Hilscher-Clarke's Hazardous Energy Control Plan*), Personal Protective Equipment (PPE) guidelines and general safety related work practices. Guidelines are also presented for specific types of work practices and the required precautionary practices when using portable electrical equipment and while being in hazardous locations. Additionally, it presents examples of labels, signs, and marking requirements.

Because every person on a Hilscher-Clarke work site is exposed to electricity, and as a result electrical related hazards, every person on a site will be affected by these safety policies and procedures.

These safety policies and procedures have been established in accordance with Occupational Safety and Health Administration (OSHA) standards for General Industry 29 Code of Federal Regulations (CFR) 1910.301-335 and OSHA standards for Construction Industry 29 CFR 1926.400-417.

Therefore, at a minimum, these requirements will be followed at Hilscher-Clarke:

- ❑ Power equipment will be plugged into wall receptacles with power switches in the off position;
- ❑ Electrical equipment will be unplugged by grasping the plug and pulling. Cords will never be pulled or jerked to unplug the equipment;
- ❑ Frayed, cracked, or exposed wiring on equipment cords must be corrected;
- ❑ “Cheater Plug” extension cords with junction box receptacle ends, or other jerry-rigged equipment will not be used;
- ❑ Temporary or permanent storage of materials must not be allowed within three (3) feet of any electrical panel or electrical equipment;
- ❑ Any electrical equipment causing shocks must be tagged with a **“Danger Do Not Use”** label, tag or equivalent.

When electrical hazards exist that cannot be eliminated, then engineering practices, administrative practices, safe work practices, Personal Protective Equipment (PPE), and proper training regarding Electrical Related Safe Work Practices will be implemented. These measures will be implemented to minimize those hazards to ensure the safety of employees *and the public*.

It is the responsibility of each manager/unit head, supervisor and employee to ensure implementation of Hilscher-Clarke's safety policy and procedure on Electrical Related Safe Work Practices. It is also the responsibility of each Hilscher-Clarke employee to report immediately any unsafe act or condition to his or her Supervisor, or Hilscher-Clarke's Safety Manager.

- ❑ Specific responsibilities are found in Section II (General Program Management).

# **Section II General Program Management**

## Program Administration

- ❑ The President, Safety Manager and all levels of Supervisory Personnel are responsible for the control of this program and ensuring that all training meets the requirements of this program. The President will maintain and update the written Electrical Safe Work Practices Plan at least annually and whenever necessary to include new or modified tasks, procedures, equipment and/or tags.
- ❑ Questions on application of this program are to be directed to a Supervisor or in his/her absence a Safety Manager.  
*NOTE: For clarification purposes, all questions and/or requests must be submitted in writing. Phone calls must be followed by written requests.*
- ❑ Hilscher-Clarke's Authorized Representative will provide a verbal response to questions within one working day and when appropriate a written response within 3 working days. The written response will be provided to every Contractor and Sub-Contractor's Site Supervisor so that all parties are kept up to date; the Contractor and Subcontractor's Site Supervisor will be the main method of getting information distributed.
- ❑ Personnel employed by Hilscher-Clarke, and all contractors and subcontractors, working at any and all worksites operated by Hilscher-Clarke are required to comply with the procedures and work practices outlined in this Electrical Safe Work Practices Policy and Procedure. The Safety Manager is responsible for ensuring that said individuals/organizations, operating under the supervision of the Hilscher-Clarke's Supervisory Personnel, are informed of and adhere to Hilscher-Clarke's Electrical Safety Program.
- ❑ With the approval of the Safety Manager, the Supervisory Personnel may delegate the responsibility of various aspects of the Electrical Safety Program to a Qualified Organization (as approved by the Safety Manager). However, the Safety Manager's and Supervisor's ultimate responsibility for his/her aspects of the program cannot be delegated.
- ❑ The **Safety Manager** is directly responsible for:
  - Designing and implementing the Electrical Safe Work Practices Training course.
  - Evaluation of electrical accidents and incidents to determine trends, and communicating these findings to management and employees.
  - Training and the Documentation of Training. (See Appendix G)
  - The Safety Manager may be requested to review electrical and electronic Equipment, at any Hilscher-Clarke work site from the standpoint of personnel and equipment safety.
  - Ensuring that PPE supplies and equipment are available and consistent with Hilscher-Clarke's standards.
  - Making the written Electrical Safe Work Practices Plan available to employees, OSHA & NIOSH Representatives.
- ❑ **All Levels of Supervisory Personnel** are directly responsible for:
  - Maintaining, administering, and suggesting revisions (of the Electrical Safe Work Practices Plan to the Safety Manager) as needed.
  - Assuring compliance with all electrical safety requirements pertaining to this program and activities involving hazardous energy on any Hilscher-Clarke work site.
  - Determining the appropriate levels of training required for each employee.
  - Ensure that the individual safe operating procedures, outlined in this plan are fully carried out by all on-site personnel, contractors, sub-contractors, and visitors.
  - Maintain a safe work environment and take corrective action on any potentially hazardous operation or condition.

## Program Administration (cont.)

- **All Levels of Supervisory Personnel (cont.):**
  - Determine the work each employee is qualified to perform and make work assignment accordingly
  - Assure that appropriate ANSI approved PPE is available and used properly.
  
- **All Employees** are responsible for:
  - Becoming acquainted with all potential hazards in the area in which they work.
  - Only perform tasks for which they are qualified.
  - Request additional training to avoid working beyond their level of qualification or comfort.
  - Follow applicable OSHA standards.
  - Learn and follow the appropriate standards, procedures, and hazard control methods.
  - Never undertake a potentially hazardous operation without consulting with an appropriate supervisor. Stop any operation believed to be hazardous.
  - Notify Supervisory Personnel of any condition or behavior that poses a potential hazard.
  - Wear and use appropriate ANSI approved PPE.
  - Immediately reporting any occupational injury or illness to their Supervisor.

# **Section III Training Requirements**

It is the responsibility of each exposed employee's immediate supervisor to ensure that the employee has received the training necessary to safely perform his or her duties. This training will be given via classroom and on-the-job instruction and is to be documented.

***Exposed Employees (non-electrical workers)*** – Workers whose job assignments require them to be close to ***exposed*** electrical circuits operating at 50 V or more, will be trained in and familiar with:

- ❑ Safety related work practices contained within 29 CFR Part 1910 section 331 through 335;
- ❑ Hazards associated with electrical energy;
  - Understanding Electricity & Conductivity (*See Appendix A*)
  - Overhead Power Line Clearance Requirements (*See Appendix B*)
  - Arcing: What You Should Know (*See Appendix C*)
  - Lockout/Tagout – A General Overview (*See Appendix D*)
- ❑ Use and care of electrical protective equipment;
- ❑ Limitations of electrical protective equipment.
- ❑ Housekeeping

***Authorized/Qualified Employee/Person (electrical workers)*** – Workers who perform electrical work will be trained to recognize the hazards associated with their work environment and use appropriate procedures and protective equipment to minimize the risk of an accident or injury. The Site Supervisor shall verify the qualifications and training of all electrical workers before they are permitted to perform electrical work.

Employee training shall be documented with respect to the specific equipment and tasks for which the employee is qualified. Much of the experience required for an employee to be considered qualified is specific to the equipment and tasks involved. On-the-job training is always a necessary component of this training qualification program.

Authorized/Qualified employees will be trained in specific hazards associated with their potential exposure. This training will include isolation of energy, hazard identification, premises wiring, connection to supply, generation, transmission, distribution installations, clearance distance, and emergency procedures.

**Authorized/Qualified persons** shall, at a minimum, be trained in and familiar with:

- ❑ Use and care of electrical protective equipment;
- ❑ Limitations of electrical protective equipment.
- ❑ The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment.
- ❑ The skills and techniques necessary to determine the nominal voltage of exposed live parts.
- ❑ Emergency procedures;
- ❑ Lockout/tagout procedures and requirements (***Hilscher-Clarke's "Hazardous Energy Control Plan" contains specific details and training requirements***);
- ❑ 29 CFR 1910.301-335 and OSHA standards for Construction Industry 29 CFR 1926.400-417.

## Training

**Outside Personnel (sub-contractors, vendors, etc.)** – Will be trained as a Hilscher-Clarke Exposed Employee or Authorized/Qualified Employee (level of training and qualification to be determined by the Site Foremen) as deemed appropriate to the individual situation(s). A Hilscher-Clarke Authorized/Qualified Employee (as outlined in this plan) may be assigned to oversee all activities of Outside Personnel to ensure compliance with the scope and applicability of this plan.

Hilscher-Clarke, reserves the right to render final judgement on any and all outside personnel as to their status, and as a result any additional required training and/or retraining, before assigning status on an individual as an “Authorized/Qualified Employee” with respect to the scope and requirements of this plan. An individual will not be allowed to commence with any activity, on the worksite, until his or her status has been established to the satisfaction of the Supervisor.

**Retraining** – may be required for an employee to maintain their “Authorized/Qualified” status. Retraining reauthorization may be required when:

- An authorized/qualified employee’s job changes or he or she is reassigned;
- New equipment is to be used;
- A Supervisor has reason to believe that an employee has inadequate knowledge of Electrical Safe Work Practices;
- An accident/incident investigation shows a deficiency in the authorized/qualified employee’s ability to perform their duties in accordance with the procedures outlined in this plan.

**Section IV  
Terms  
&  
Definitions**

The following terms and acronyms are used in this document and the supporting appendices.

**Affected Employee** – Any employee (including subcontractors) whose job requires him/her to operate or use a machine or work in an area where service or maintenance of equipment is being performed.

**ac** – Alternating current.

**ANSI** – American National Standards Institute.

**Authorized Person** – Any employee (including subcontractors) with acquired skills and training who has been approved or assigned by the supervisor to perform specific work or tasks.

**Bonding** – The permanent joining of metallic parts to form an electrically conductive path that will ensure electrical continuity and the capacity to conduct safely and current likely to be imposed.

**CFR** – Code of Federal Regulations.

**Competent Person** – A person who is (1) capable of identifying existing and predictable hazards in workplaces; and (2) authorized and qualified by management to take prompt corrective measures to eliminate hazards, provide first aid, and notify the appropriate personnel when an accident or incident occurs.

**CPR** – Cardiopulmonary resuscitation.

**dc** – Direct current.

**Electrical Equipment** – A general term for material, fittings, devices, appliances, fixtures, apparatus, and the like that are used as a part of or in connection with an electrical installation. The term applies to both power-generation equipment and electronics equipment.

**Electrical Hazard** – Any situation in which an employee or any conductive tool or object in contact with the employee could contact or approach closer than the safe clearance distance of any live part or other energized conductor. Any situation in which electrical

equipment is likely to cause a fire because of defective components or design. Examples of electrical hazards include inadequate working clearance while working on energized circuits, exposed energized parts, electrical equipment inadequately guarded or enclosed, electrical equipment in an unsafe environment and unsafe electrical equipment. Generally, electrical equipment that is not in compliance with OSHA regulations or NEC standards presents a potential hazard.

**Electrical Worker** – Person trained, qualified, and authorized to work on electrical equipment. He/she is usually hired specifically for this purpose.

**GFCI** – Ground Fault Circuit Interrupter.

**Grounded** – Connected to earth or to some conducting body that serves in place of the earth. Physically and intentionally connected to the earth through a ground connection of sufficient low impedance and with sufficient current-carrying capacity to prevent the buildup of voltages that may result in undue hazard to connected equipment or persons. (See Ungrounded).

**Labeled** - Equipment or materials to which a label, symbol, or other identifying mark has been applied by an NRTL.

**Listed** – Equipment or materials included in a list published by an NRTL.

**Live/Energized Parts** – The current edition of 29 CFR 1910 defines a “live part” as an electrically conducting part carrying more than 50 V ac or dc. (A part may be designated as “not live” if the current from the part to ground through 1500 ohms non-inductive resistance shunted by a capacitance of 0.15  $\mu$ f cannot exceed 0.5 mA, even though the part carries voltage equal to or greater than that specified for a live part.)

## Terms & Definitions

**Lockout/Tagout Procedure** – Hilscher-Clarke’s general procedure (detailed in the Hazardous Energy Control Plan, and briefly outlined in Appendix D of this plan) for affixing appropriate locks and tags to energy-isolating devices to prevent inadvertent energizing or start-up of machines or equipment while service and maintenance is being performed. Lockout devices prevent the release of energy that could cause injury or death.

**Minimum Work Distance or Clearance** – A minimum separation distance between a qualified electrical worker (or any conducting object touching the worker) and any energized component. Also, a mandatory separation distance between any energized component and vehicles or machinery.

**NEC** – National Electrical Code.

**NEMA** – National Electrical Manufacturers Association.

**NFPA** – National Fire Protection Association.

**NRTL (Nationally Recognized Testing Laboratory)** – An organization that is concerned with product evaluation and maintains periodic inspection of listed equipment and materials. The NRTL ensures that the equipment or materials meet

appropriate designated standards and that they have been tested and found to be suitable for use in a specified manner.

**OSHA** Occupational Safety and Health Administration.

**PPE** – Personal Protective Equipment.

**Qualified Person** – A person who has been determined by his/her supervisor to have the skills, knowledge, and abilities to safely perform the work to which he/she is assigned. Qualifications may include a recognized degree, certificate, or professional standing – through extensive knowledge, training, and experience – or that one has successfully demonstrated the ability to resolve problems relating to the subject matter or work to the satisfaction of his/her supervisor.

**Temporary Wiring** – Electrical wiring that is temporarily installed for a limited time to complete a specific task (e.g., construction of a new facility). Temporary wiring methods must apply sound engineering practices to ensure adequate electrical safety of temporary wiring installations.

**Ungrounded** – A condition having no physical connection or continuity with earth ground. A condition of insulation or isolation (see Grounded).

# **Section V**

## **Electrical Safe**

### **Work Practices**

## 1.0 Principles (Implementation Policy)

It is Hilscher-Clarke's policy to follow the fundamental principles of safety described below. A clear understanding of these principles increases the safety of those who work with or around electrical equipment.

- 1.1 Practice proper housekeeping and cleanliness.** Poor housekeeping is a major factor in many accidents. A cluttered area is likely to be both unsafe and inefficient. Every employee is responsible for keeping a clean area, and every Supervisor is responsible for ensuring that his or her areas of responsibility remain clear.
- 1.2 Identify hazards and anticipate problems.** Think through what might go wrong and the consequences of that action. Do not hesitate to discuss any situation or question with your Supervisor and co-workers.
- 1.3 Resist "hurry-up" pressure.** Program pressures should not cause you to bypass thoughtful consideration and planned procedures.
- 1.4 Design for safety.** Consider safety to be an integral part of the design process. Protective devices, warning signs, and administrative procedures are supplements to good design – not a substitute for it. Engineering controls are always preferable to administrative controls. Completed designs should include provisions for safe maintenance.
- 1.5 Maintain for safety.** – Good maintenance is essential to safe operations. Maintenance procedures and schedules for servicing and maintaining equipment and facilities, including documentation of repairs, removals, replacements, and disposals, should be established.
- 1.6 Document your work.** – An up-to-date set of documentation adequate for operation, maintenance, testing, and safety should be available to anyone working on potentially hazardous equipment. Keep drawings and prints up to date. Dispose of obsolete drawings and be certain that active file drawings have the latest corrections.
- 1.7 Have designs reviewed.** – All systems and modifications to systems performing a safety function or controlling a potentially hazardous operation must be reviewed and approved at the level of Safety Manager or above.
- 1.8 Have design and operation verified.** – All systems performing safety functions or controlling a potentially hazardous operation must be validated by actual test procedures before being placed in service, at least once a year, and anytime the system is suspected of malfunction. Both the procedures and actual tests must be documented.
- 1.9 Test equipment safety.** – conduct tests with the electrical equipment de-energized, or, if the equipment cannot be de-energized, with reduced hazard.
- 1.10 Know emergency procedures.** – All persons working in areas of high hazard (with high-voltage power supplies, capacitor banks, etc.) must be trained in emergency response procedures, which shall include cardiopulmonary resuscitation (CPR) certification.

## 2.0 Safe Work Practices

- 2.1 Beware of wet areas.** – While working with liquids (i.e., washing, mopping, and spraying), exercise extra care to avoid contact with electrical outlets or devices. Cover electrical openings if liquids can penetrate them. If the openings cannot be covered, the power must be disconnected and locked. (*See Hilscher-Clarke's Hazardous Energy Control Program*).
- 2.2 Use electrical devices only as intended.** – Electrical devices may not be modified beyond the intent of their design. Electrical equipment is only safe when it is used according to its intended purpose. Some examples of misuse of electrical equipment are:
- Pulling out a plug by the cord rather than by the plug.
  - Inserting wires or objects other than a standard plug into a receptacle outlet.
  - Home-made or “cheater plug” extension cords with junction box receptacle ends, or other jerry-rigged equipment will not be used.
  - Deforming a contact to enable it to fit a receptacle for which it was not intended.
- 2.3 Always consider electrical equipment energized unless positively proven otherwise.** When working on electrical equipment, treat the equipment as live until it is tested, locked, tagged, shorted and/or grounded as appropriate.
- 2.4 Re-set circuit breakers only after the problem has been corrected.** When a circuit breaker or other overcurrent device trips, it is usually due to an overload or fault condition on the line. Repeated attempts to re-energize the breaker under these conditions may cause the breaker to explode. Do not attempt to re-set a circuit breaker unless the problem has first been identified and corrected or isolated.
- 2.5 Whenever possible, all circuits or equipment shall be de-energized before beginning work.** Work on energized circuits shall only be performed by Authorized/Qualified workers, as described in Section III of this plan. In addition these workers shall use:
- 2.5.1** Proper design, fabrication, installation, and documentation techniques;
  - 2.5.2** Proper operational and maintenance procedures;
  - 2.5.3** Electrical equipment approved by a nationally recognized testing laboratory (NRTL).
  - 2.5.4** Proper personal protective equipment (PPE).
- 2.6 Only authorized and qualified individuals are permitted to perform electrical work on a Hilscher-Clarke controlled work site.** An Authorized/Qualified person is one who has the required skills and knowledge (as outlined in Section III of this plan) to perform electrical work safely. These individuals are aware of the hazards associated with electrical work and the methods for reducing the risk of electrical accidents that can result from unsafe equipment, adverse environmental conditions, and unsafe acts.
- 2.7 Temporary or permanent storage of materials** – will not be allowed within three (3) feet of any electrical panel or electrical equipment.
- 2.8 Electrical equipment causing shocks.** Any electrical equipment causing shocks must be tagged with a “Danger-Do Not Use” label or equivalent and immediately removed from service.
- 2.9 Conductive Materials and Equipment** – Conductive materials and equipment (i.e., hand tools) will be handled to prevent contact with exposed energized conductors or circuit parts. Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) will not be worn.

## 2.0 Safe Work Practices (cont.)

- 2.10** When electrical hazards exist that cannot be eliminated, then engineering practices, administrative practices, PPE and proper training regarding Electrical Related Safe Work Practices will be implemented. These measures will be implemented to minimize those hazards to ensure the safety of employees and the public.
- 2.11 Portable Ladders** – will have nonconductive surfaces if they are used where the employee or the ladder could be exposed to electrical shock hazards (see Appendix F).

## 3.0 Portable Electrical Equipment/Tools

Portable power tools are designed for particular tasks and if used for other purposes other hazards may be created. Additionally, the extreme mobility of these tools and their power sources creates significant hazards.

**3.1** Employees using power tools will be provided with Personal Protective Equipment (PPE) when exposed to falling, flying, abrasive and splashing objects, or harmful dusts, fumes, vapors, gases and/or electrical hazards.

**3.2 Inspection:** The Site Supervisor will ensure that all portable power tools are being inspected by the Affected Employee prior to each use. The employee will be instructed to:

- Inspect tools for any damage prior to each use.
- Check the handle and body casing of the tool for cracks or other damage.
- If the tool has auxiliary or double handles, check to see that they installed securely.
- Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.
- Check for damaged switches and ones with faulty trigger locks.
- Inspect the plug for cracks and for missing, loose or faulty prongs.

### 3.3 Defective Tools

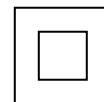
- If a tool is defective, remove it from service, and tag it clearly “Out of Service For Repair”.
- Replace damaged equipment immediately – do not use defective tools “temporarily”.
- Have tools repaired by a qualified person – do not attempt field repairs.

### 3.4 Electric Tools - Basic Safety:

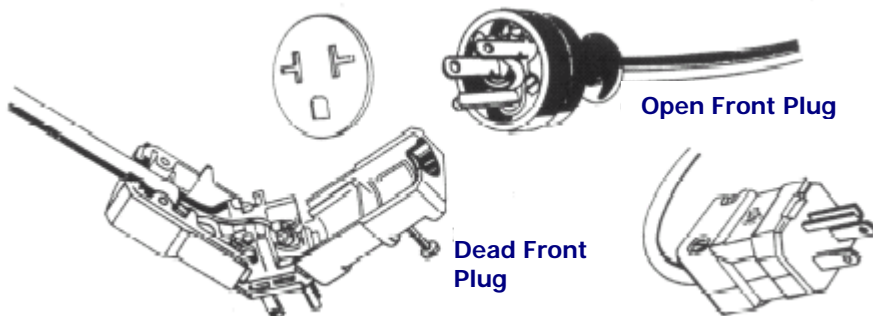
- The tool must be properly grounded or double-insulated.
- “Properly Grounded” means an approved three-wire cord with a three-prong plug. You should only use the tool in a three-pole outlet or receptacle.
- Never cut off or bend back the ground pin on a three-prong plug to make it fit in a two-pole receptacle. Never use a two-prong cheater or adapter.
- If the tool is double-insulated, it will be labeled. There are different labels in use, below are examples of the three most common symbols:

D

D



- Make sure that the casing of a double-insulated tool is not cracked, split, or broken.
- Replace open front plugs with dead front plugs. Dead front plugs are sealed. They present less danger of shock or short-circuit.



### 3.0 Portable Electrical Equipment/Tools (cont.)

- Whether the tool is grounded or double-insulated, test it with a continuity tester or a CFCI before use.
- Inspect tool cords and extension cords daily for damage.
- Keep cords clear of the tool during use.
- Check extension cords and outlets with a circuit-tester before using them.
- Inspect tool cords and extension cords for kinks, cuts, cracked or broken insulation, and makeshift repairs.
- Don't use the cord to lift, lower, or carry an electric tool. Don't disconnect the tool by yanking or jerking on the cord. You'll damage the cord, loosen connections, and run the risk of shocks and short-circuits.
- Protect tool cords and extension cords from traffic. Run them through conduit or between plans along either side. If necessary, run cords overhead above work or travel areas.
- Report any shocks from tools or cords to your supervisor. Minor shocks can be a warning of fatal shocks later if tools and cords are not checked.
- Hilscher-Clarke requires ground fault circuit interrupters to be used with all electrical tools regardless of location. GFCIs detect any current leaking to ground from a tool or cord and quickly cut off power before damage or injury can occur.
- Never plug several power cords into one outlet by using single-to-multiple outlet adapters or converters ("cube taps").

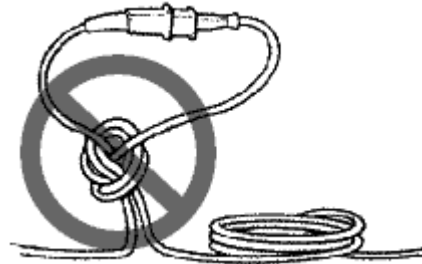
## 4.0 Extension Cords

### 4.1 Extension Cord Construction:

- Extension cords shall be listed by the Underwriters' Laboratory (U.L.) and bear the U.L. label.
- Flexible extension cords shall be of the grounding type (three wire) and shall be constructed from type S, hard usage material. When cords are used with heating appliances, a type HS cord is required.
- Flexible extension cords shall not be used in excess of their rated capacity.
- Extension cords shall be used only in continuous lengths without splice or tap. Terminals and insulation shall be free of defects such as cracked, split or nicked insulation; exposed wires; knots; burn marks; loose connectors; or other damage that may present a fire or electrocution hazard. All extension cords showing defects shall be immediately turned over to the Site Supervisor who will promptly destroy them.

### 4.2 Extension Cord Use and maintenance:

- Extension cords shall not be used as a substitute for the fixed/permanent wiring on any Hilscher-Clarke worksite.
- Extension cords shall not be tacked, stapled or otherwise affixed in semi-permanent or permanent manner.
- Multiple outlet adapters (octopus adapters) are not permitted for use on a Hilscher-Clarke worksite.
- Extension cords shall not be used on stationary equipment or equipment drawing more than 15 amps, such as power tools, refrigerators, television, etc.
- Do not connect or splice extension cords together to make a longer connection: the resulting extension cord may not be able to provide sufficient current or power safely.
- Extension cords shall not run through behind or in walls, ceilings or floors or other concealed space. Nor shall they be run in or through ventilation ducts.
- Extension cords shall not be placed under carpets, under doors, or other locations that subject the cord to abrasion or other damage and which would prevent adequate air circulation and cooling of the cord.
- Avoid creating a tripping hazard; do not place extension cords across walkways.
- Where hazardous atmospheres may exist, due to the presence of flammable gases or vapors or explosive dusts, extension cords shall not be used.
- The combined length of the appliance cord and extension cord that is used on very portable equipment, such as a floor sander, floor scrubber, hand tools, etc. shall not exceed 105 feet.
- Extension cords used outside, in bathrooms, kitchens, or in wet or damp areas shall be connected to a ground fault interrupter device or GFCI circuit only.
- Do not tie power cords in knots. Knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.



## 5.0 Static Electricity

A static charge is an imbalance of electrons on objects (matter) that can build up on all matter and transfer from one object to another by conduction or induction. The discharge of static electricity can cause shock or a fire or explosion. Although this type of shock is painful, it is not normally physically hazardous and therefore is not considered reportable as an electric shock. It should be noted, however, that injuries may result from reaction to the shock (i.e., by a person rapidly pulling his/her hand away from a metal object and hitting an elbow against a wall or cabinet).

**5.1 Equipment & Personnel Guidelines:** When working with electrical equipment, employees shall follow the guidelines outlined below for their own protection and that of the equipment.

**5.1.1 Grounding of the metal parts or enclosures** will continuously discharge static. Therefore, wrist straps and other connections used to ground employees shall be solidly grounded where static-safe workstations are used for semiconductor, electronic, or explosive work. Grounding prevents the wrist strap from becoming a shock hazard in the event of a short circuit from a voltage to the wrist-strap conductor.

**5.1.2 Bonding** will equalize the potential between two adjacent noncurrent-carrying metal parts or enclosures. Thus, only approved or listed grounding clamps are acceptable for static bonding and grounding. Alligator clamps are not acceptable.

**5.1.3 Dust** is attracted to the face of the video display terminal because of a static charge of approximately 25,000 V. Therefore, never clean the glass face of a computer monitor while the computer is on. When a person touches the screen with a finger, the charge in the portion of the screen touched discharges through the finger with a tiny spark. Electric current does not normally flow through glass, so only the charge on that part of the screen the finger touches is discharge. When cleaning a monitor, however, the entire glass is wet and the charge on the entire screen will discharge to a finger or hand causing a much more painful shock.

**5.1.4** Never allow any electrical-powered office equipment to become wet while it is turned on, and never turn on any electronic equipment when it is wet. Even when a computer is turned off for a few minutes, it is best not to touch the monitor's CRT while handling or using other electronic equipment-including the telephone. Wet or dry, a person may receive an electric shock similar to one that can be received by touching a metallic object when vacuuming, machining a dielectric, or walking across carpeting in leather shoes.

**5.2 NFPA Regulations for Fire and Lightning** - NFPA 77 (Static Electricity) contains requirements for reducing the fire hazard of static electricity. Lightning, an example of static electricity, is covered in NFPA 78 Lightning Protection Code). This document gives lightning protection requirements for ordinary facilities containing flammable vapors, gases, or liquids.

**5.2.1 *Flammable Vapor.*** A flammable vapor source can be ignited by static electricity if the following conditions exist simultaneously:

- Generation of a static charge imbalance;
- Static charge accumulation;
- Flammable atmosphere;
- A spark with significant ignition energy or temperature.

## 5.0 Static Electricity (cont.)

**5.2.2 Liquids.** Electrostatic charges can be generated by the movement of liquid through pipes, funnels, pumps, filters, or by free-blowing through air. Static charges generated by flowing liquids can be reduced or eliminated by bonding or grounding, or both; by lowering the flow rate; or by reducing the amount of misting, spraying, free-fall, and splashing of the liquid. Pay particular attention to situations where the liquid stream may impinge on a connection to a capacitor, high-voltage bushing, or cable terminal. Static charge from the liquid can store hazardous quantities of electrical energy in a capacitor over time. This hazard is most likely to occur when filling electronic apparatus tanks with insulating oil.

## 6.0 Hazardous Locations

Portable electric equipment and flexible cords used in highly conductive work locations or in job locations where employees are likely to contact water or conductive liquids shall be approved by the manufacturer for those locations. The hazardous locations that employees should be aware of include, wet locations and locations where combustible or flammable atmospheres are present.

*(See Section 4.0 of this Policy and Procedure for additional related information).*

- 6.1 For Wet Locations** – employee’s hands will not be wet when plugging and unplugging energized equipment. Energized plug and receptacle connections will be handled only with protective equipment if the condition could provide a conductive path to the employee’s hand (i.e., a cord connector is wet from being immersed in water). In addition, ground-fault circuit interrupters (GFCI) protection is required for some equipment/locations and is also recommended for use in all wet or highly conductive locations.
- 6.2 For Combustible/Flammable Atmospheres** – all electrical equipment and wiring systems in classified locations must meet the National Electric Code requirements for that particular classification.

## 7.0 Personal Protective Equipment

**7.1** Personal protective equipment is required when installing, examining, adjusting, servicing, fabricating, testing, or maintaining electrical equipment. The Safety Manager and Site Supervisor shall provide employees with appropriate PPE, and shall ensure that the equipment is used properly. PPE shall meet the following ANSI and ASTM Standards:

Protective Equipment or Apparel	ASTM Standard	ANSI Standard
Rubber, Insulating Gloves	D 120	–
Rubber, Insulating Matting	D 178	–
Rubber, Insulating Blankets	D 1048	–
Rubber, Insulating Covers	D 1049	–
Rubber, Insulating Line Hose	D 1050	–
Rubber, Insulating Sleeves	D 1051	–
Protective Foot Wear	–	Z41
Eye and Face Protection	–	Z87.1
Nonconductive Hard Hats (Helmets)	–	Z89.2
Leather Protectors For Rubber Insulating Gloves	F 696	–

**7.2** To prevent injury from exposure to electrical hazards, it's important that all electrical personal protective equipment (PPE) and electrical equipment be maintained in a safe, reliable condition. Electrical equipment includes, but is not limited to:

**7.2.1** Nonconductive hard-hats, gloves, and foot protection or insulating mats.

**7.2.2** Eye and face protection whenever there is danger from electric arcs or flashes.

**7.2.3** Insulated tools or handling equipment.

**7.2.4** Protective shields and barriers to protect against electrical shock and burns.

**7.3** Two types of rubber insulating gloves will be used by Hilscher-Clarke as a portable device for protecting employees from contact with live electrical conductors:

**7.3.1** Low voltage, Type I (being non-resistant to ozone breakdown), Class 0 (capable of withstanding 5,000 volts);

**7.3.2** High voltage, Type I (being none-resistant to ozone breakdown), Class I (capable of withstanding (10,000 volts).

**7.4 Rubber gloves** are required to prevent employee electrocution from accidental contact with energized equipment. Rubber gloves shall not be used as primary protection. Primary protection measures include grounding and deactivation.

**7.4.1** To make sure electrical protective equipment actually performs as designed, it must be inspected for damage prior to each use, and immediately following any incident that can reasonably be suspected of having caused damage.

## 7.0 Personal Protective Equipment (cont.)

- 7.4.2** Insulating gloves must be given an air test, along with the inspection.
- 7.4.3** Each glove must be conspicuously marked with last test date and expiration date.
- 7.4.4** All electrical protective equipment, made of rubber, should meet the established safety standards and specifications outlined in the table below:

**Table 7.4.5**

<b>Rubber Insulating Equipment Voltage Requirements</b>			
<b>Class of Equipment</b>	<b>Maximum Use Voltage (1) a – c- rms</b>	<b>Retest Voltage (2) a – c - rms</b>	<b>Retest Voltage (2) d – c - avg</b>
<b>0</b>	<b>1,000</b>	<b>5,000</b>	<b>20,000</b>
<b>1</b>	<b>7,500</b>	<b>10,000</b>	<b>40,000</b>
<b>2</b>	<b>17,000</b>	<b>20,000</b>	<b>50,000</b>
<b>3</b>	<b>26,500</b>	<b>30,000</b>	<b>60,000</b>
<b>4</b>	<b>36,000</b>	<b>40,000</b>	<b>70,000</b>

**Footnote(1)** The maximum use voltage is the a-c voltage (rms) classification of the protective equipment that designates the maximum nominal design voltage of the energized system that may be safely worked. The nominal design voltage is equal to the phase-to-phase voltage on multiphase circuits. However, the phase-to-ground potential is considered to be the nominal design voltage:

[1] If there is no multiphase exposure in a system area and if the voltage exposure is limited to the phase-to-ground potential; or

[2] If the electrical equipment and devices are insulated or isolated or both so that the multiphase exposure on a grounded wye circuit is removed.

**Footnote(2)** The proof-test voltage must be applied continuously for at least 1 minute, but no more than 3 minutes.

- 7.5 Testing of Rubber Insulated Gloves.** Rubber insulating gloves will be tested annually to ensure that their protective ability against shock has not been compromised. The testing will be performed by a certified testing company (chosen by the Safety Manager). The gloves will be approved and stamped for use or replaced when necessary.
- 7.6 Use of Rubber Matting.** Employees working on energized or potentially dangerous equipment will be provided with rubber matting on which to stand. This matting will be capable of withstanding an electrical charge of 30,000 volts.
- 7.7 Rubber Matting Replacement.** Rubber matting will be replaced on an annual basis (without testing) to ensure its capability to eliminate injury.
- 7.8 Rubber-insulated (nonconductive) protective equipment shall be visually inspected;**
- At the beginning of each workday;
  - Before each use; and
  - Immediately following any incident that can reasonably be suspected of having caused damage.
- 7.8.1** This inspection shall include an air test of the gloves used. Hot sticks, grounds, aerial-lift equipment and booms, hot rope, and hot ladders shall also be visually inspected as specified by the individual manufacturer's guidelines.

## 7.0 Personal Protective Equipment (cont.)

### 7.9 Defects – Insulating equipment must not be used if any of the following defects are detected:

- A hole, tear, puncture, or cut;
- Ozone cutting or ozone checking (the cutting action produced by ozone on rubber under mechanical stress can turn into a series of interlacing cracks);
- An embedded foreign object;
- Any of the following texture changes: swelling, softening, hardening, or becoming sticky or inelastic; and
- Any other defect that damages the insulating properties.

**7.9.1** Insulating equipment found to have other defects that might affect its insulating properties must be removed from service and returned for testing.

**7.9.2** Insulating equipment must be cleaned as needed to remove foreign substances, and stored in such a location and in such a manner as to protect it from light, temperature extremes, excessive humidity, ozone, and other injurious substances and conditions.

### 7.10 Gloves:

**7.10.1 Protector Gloves** must be worn over insulating gloves, except when using Class 0 gloves, under limited use conditions, where small equipment and parts manipulation necessitate unusually high finger dexterity.

***NOTE: Extra care must be taken while visually examining the glove, and make sure employees are instructed not to avoid handling sharp objects in this type of situation.***

**7.10.2** Any other class of glove may be used for similar work without protector gloves if the Supervisor can demonstrate that the possibility of physical damage to the insulating gloves is small and if the class of glove is one class higher than that required for the voltage involved.

- Insulating gloves that have been used without protector gloves ***may not*** be used at a higher voltage until they have been tested.

**7.10.3 Leather Gloves** - Leather gloves will be worn over insulating gloves to ensure the insulating gloves are not punctured or damaged during their use.

### 7.11 Testing – Electrical protective equipment must be subjected to periodic electrical tests. Test voltages and the maximum intervals between tests must be in accordance with Table 7.4.5 and Table 7.11.1:

**Table 7.11.1**

Rubber Insulating Equipment Test Intervals	
Type of Equipment	When To Test
Rubber Insulating Line Hose	Upon indication that insulating value is suspect.
Rubber Insulating Covers	Upon indication that insulating value is suspect.
Rubber Insulating Blankets	Before first issue and every 12 months thereafter (1).
Rubber Insulating Gloves	Before first issue and every 6 months thereafter (1).
Rubber Insulating Sleeves	Before first issue and every 12 months thereafter (1).
<p><b>Footnote(1)</b> 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.</p>	

## 7.0 Personal Protective Equipment (cont.)

- 7.11.2** The test method used must reliably indicate whether the insulating equipment can withstand the voltages involved.
- 7.11.3** Repaired insulating equipment must be retested before it may be used by any Hilscher-Clarke employee (regardless of status).
- 7.11.4** If the insulating equipment fails to pass inspections or electrical tests it may not be used by employees, except as follows:
- Rubber insulating line hose may be used in shorter lengths with the defective portion cut off.
  - Rubber insulating blankets may be repaired using a compatible patch that results in physical and electrical properties equal to those of the blanket.
  - Rubber insulating blankets may be salvaged by severing the defective area from the undamaged portion of the blanket. The resulting undamaged area may not be smaller than 22 inches x 22 inches (560mm by 560mm) for Class 1,2,3, and 4 blankets.
  - Rubber insulating gloves and sleeves with minor physical defects (i.e., small cuts, tears, or punctures) may be repaired by the application of a compatible patch.
  - Rubber insulating gloves and sleeves with minor surface blemishes may be repaired with a compatible liquid compound.
  - All patched areas, on rubber insulating equipment, must have electrical and physical properties equal to those of the surrounding material.
  - Repairs to gloves are permitted only in the area between the wrist and the reinforced edge of the opening.

**7.12 Rubber Insulating Equipment Certification** – Hilscher-Clarke must certify that equipment has been tested in accordance with the requirements of the standard, and the certification must identify the equipment that passed the test and the date it was tested.

- Each glove must be conspicuously marked with last test date and expiration date.

## 8.0 Labels, Signs, and Markings

- 8.1 Barricades, safety signs, safety symbols, or accident prevention tags will be used where necessary to warn and protect employees from contact with electrical hazards.
- 8.2 Electrical equipment may not be used unless the manufacturer's name, trademark, or other descriptive marking is placed on the equipment.
- 8.3 Other markings shall be provided giving voltage, current, or wattage. The marking shall be of sufficient durability to withstand the environment involved.
- 8.4 Covers for boxes shall be permanently marked "High Voltage." The marking shall be on the outside of the box cover and shall be readily visible and legible.



## 9.0 Work On Electrical Components and Systems

- 9.1** Any live electrical parts shall be positively de-energized when working on or near electrical circuits, equipment, or systems. Circuits and equipment must be considered energized until isolated, locked out and tagged, and verified with an appropriate testing device. Where it is possible for the circuits to be energized by another source, or where capacitive and/or inductive devices (including cables) may retain or build up a charge, circuits shall be grounded and shorted. Exceptions to this paragraph may be permitted when the requirements in Hilscher-Clarke's Hazardous Energy Control Plan are fulfilled.
- 9.2** Additionally, the following precautions shall be observed to improve electrical safety at Hilscher-Clarke's work sites:
- 9.2.1** Identify and report to your Supervisor potential electrical hazards or unexpected occurrences or incidents (i.e., discharges or arcs when applying grounds to circuits thought to be de-energized), including near misses.
  - 9.2.2** Anticipate potential electrical problems and hazards.
  - 9.2.3** Do not rush to finish a job; never bypass approved procedures.
  - 9.2.4** Plan and analyze for safety during each step of any electrical work.
  - 9.2.5** Keep accurate records (i.e., as-built designs) of all pertinent work performed on a project.
  - 9.2.6** If you must design and construct equipment, do so to protect personnel. First-line and backup safeguards should be provided to prevent personnel from accessing energized circuits. Establish periodic tests to verify that these protective systems are operative.
  - 9.2.7** Use properly rated test equipment and verify its condition and operation before and after use. Electrical equipment is considered safe only when it is used as specifically intended by its listing and design. Equipment must not be altered beyond the original design intent and must not be used for any purpose other than that for which it was constructed.
  - 9.2.8** Any equipment that is being re-commissioned must be examined and/or tested, as appropriate, to verify the status of all safety features and the integrity of construction.
  - 9.2.9** Know applicable emergency procedures.

## 10.0 Temporary Wiring

- 10.1 Construction Power and Lighting.** Temporary wiring for electric power and lighting is permitted during periods of construction, remodeling, maintenance, repair, or demolition or equipment or structures and during emergencies. Temporary wiring does not mean a “reduced” level of safety or quality, as this wiring must still conform to certain criteria for electrical work.
- 10.2 Temporary Wiring** shall have a temporary wiring tag attached to it with the following information:
- 10.2.1** Review/Approval and signature of the Safety Manager and/or Site Supervisor.
  - 10.2.2** The reason for the temporary wiring (i.e., emergency, construction, test, and/or research and development).
  - 10.2.3** Installation date.
  - 10.2.4** Name, phone number, and pager number (if applicable) of the person installing the temporary wiring tag.
- 10.3** All temporary wiring shall be installed with approved overload protection and maintained in accordance with the following:
- 10.3.1** Main feed and secondary conductors shall be no less than eight feet above the floor or ground level unless in rigid or other conduit such as nonmetallic sheathed cable or metallic sheathed cable which provides equivalent protection and support. Temporary wiring run as open conductors shall be on insulators spaced no more than ten (10) feet apart and shall not be exposed to mechanical damage. Extension cords shall not be considered as secondary conductors. No branch circuits, or feeder conductors shall be laid on the floor except properly maintained extension cords feeding portable powered tools.
  - 10.3.2** All receptacles shall be grounded effectively.
  - 10.3.3** All lamps for general illumination shall be protected from accidental contact or breakage. Protection shall be provided by elevation of no less than seven (7) feet from normal working surface or by a suitable fixture or lampholder with a guard.
  - 10.3.4** All temporary circuits shall be grounded effectively.
- 10.4** No bare conductors nor earth returns shall be used for the wiring of any temporary circuit.
- 10.5** Approved disconnecting switches or plug connectors shall be installed to permit the disconnection of all ungrounded conductors of each temporary circuit.
- 10.6** All 120 volt single-phase 15 and 20 ampere receptacle outlets which are not a part of the permanent wiring of the building or structures, shall have ground fault circuit interrupters or the implementation of an assured equipment grounding program on construction sites.
- 10.7** All energized equipment exposed to contact shall be guarded.
- 10.8** Portable lights in wet or damp locations shall not exceed 12 volts.
- 10.9** All temporary wiring shall be removed as soon as the prescribed activity is completed. It shall not be used as a substitute for permanent wiring.

## 11.0 Electrical Shock

Electrical shock occurs when a person comes in contact with two conductors of a circuit or when the body becomes part of the electrical circuit. In either case, a severe shock can cause the heart and lungs to stop functioning. Also, severe burns may occur where current enters and exits the body.

Most electrical fatalities occur at voltages of less than 500 volts, and a large number of those occur on 115 volt circuits and equipment. Those voltages are most likely to cause “ventricular fibrillation,” irregular, rapid contractions of the muscle fibers of the heart that do not respond to cardiopulmonary resuscitation (CPR). Higher voltages are less likely to cause this deadly condition, but they can cause more severe burning. And shocks that are not severe enough to electrocute can still result in death because of their effect on muscles. (For example, a person who is mildly shocked can fall to his or her death from a ladder or scaffold.)

It’s not the voltage but the current that kills. People have been killed by 100 volts AC and with as little as 42 volts DC. The real measure of a shock’s intensity lies in the amount of current (in milliamperes) forced through the body.

Current between 100 and 200 milliamperes (0.1 ampere and 0.2 ampere) are fatal. 10 milliamperes (0.1) is capable of producing painful to severe shock. Reference Table 11.1 (below):

### 11.1 Effects of electrical shocks:

**Table 11.1**

Readings	Current	Effects
Safe Current Values	1 mA or Less	Causes no sensation – not felt.
	1 mA to 8 mA	Sensation of shock, not painful; Individual can let go at will since muscular control is not lost.
Unsafe Current Values	8 mA to 15 mA	Painful shock; individual can let go at will since muscular control is not lost.
	15 mA to 20 mA	Painful shock; control of adjacent muscles lost; victim cannot let go.
	50 mA to 100 mA	Ventricular fibrillation – a heart condition that can result in death is possible.
	100 mA to 200 mA	Ventricular fibrillation occurs.
	200 mA and Over	Severe burns, severe muscular contraction – so severe that chest muscles clamp the heart and stop it for the duration of the shock. (This prevents ventricular fibrillation.)

### 11.2 Accident victims can incur the following injuries from electrical shock:

- Low-voltage contact wounds;
- High-voltage contact wounds from entry and exit of electrical current;
- Burns;
- Respiratory difficulties – the tongue may swell and obstruct the airway; or vaporized metal or heated air may have been inhaled);
- Infectious complications;
- Injury to bone through falls, heat necrosis (death of tissue) and muscle contraction (shoulder joint injuries and fracture of bones in the neck are common injuries caused by muscle contraction);

## 11.0 Electrical Shock (cont.)

- Injury to the heart such as ventricular fibrillation, cardiac arrest or stoppage.
- Internal and organ injuries;
- Neurological (nerve) injury; and
- Injury to the eyes.

**11.3 Shock Rescue Procedures** – In response to an electrical accident, follow these procedures immediately:

**11.3.1** If possible immediately de-energize the circuit.

**11.3.2** Separate the person from the energy source:

- Make sure you and the victim are in a safe zone – not in contact with any electrical source, away from downed or broken wires.
- Never grab the person or pull the person off the current with your hands, you might become part of the circuit and become injured as well.
- Use a dry wood broom, leather belt, plastic rope or something similar that is non-conductive such as wood or plastic to pull, or push, the person free from the energy source.

**11.3.3 Call for emergency assistance.** Never attempt to deal with an electrical shock victim totally on your own. You need to get emergency services responding to your scene as soon as possible.

**11.3.4** Administer First Aid/CPR only if you have been properly trained and certified to do so.

**11.3.5** Keep the victim lying down, warm and comfortable to maintain body heat until help arrives. Do not move the person in case of injury to neck or back.

**11.3.6** Even for mild shocks, make sure the victim receives professional medical attention. The victim could have heart failure hours after the shock occurs.

### **11.4 Burn Victim First Aid Steps:**

**11.4.1** If the person's clothing is on fire, roll the person on the ground to smother the flames.

**11.4.2** Cool the burn with water or saline for a few minutes or until the skin returns to normal temperature. Do not attempt to remove clothing that is stuck to a burn.

**11.4.3** Cover the burned area with a clean and sterile dressing.

**11.4.4** Remove constricting items from the victim, such as shoes, belts, jewelry and tight collars. They could continue to burn or cut off circulation if the victim experiences swelling.

**11.4.5** Check the victim's breathing and heartbeat. Apply mouth-to-mouth resuscitation and/or CPR if necessary, and only if you have been properly trained and certified to do so.

**11.4.6** Keep victim warm and comfortable by covering him/her with clean, dry sheets or blankets.

**11.4.7** Elevate burned areas to reduce swelling.

**11.4.8** Even for mild burns, make sure the victim receives professional medical attention. Infection can occur in any burn, no matter how minor.

## 12.0 Multiple Outlet Boxes

**12.1** Observe the following precautions when using multiple outlet boxes:

**12.1.1** Each multiple outlet box shall be plugged into a wall receptacle. *Use of one outlet box to provide power to one or more outlet boxes is not permitted, under any circumstances, on any Hilscher-Clarke work site.*

**12.1.2** Outlet boxes shall not be used to provide power to space heaters, hot plates, coffee pots, or other high-current loads. These types of appliances have caused outlet boxes to burn up.

**12.1.3** Multiple outlet boxes that are used in offices, as well as those used to provide surge protection for computers, do not require a temporary wiring tag.

## 13.0 Flexible Cords and Cables

- 13.1** This section covers use of flexible cord, as a wiring method, and cord-and-plug assemblies that provide ac power for machines and equipment. Flexible cords and cables shall comply with the requirements in NEC Article 400 (Flexible Cords and Cables). They shall not be :
- 13.1.1** Used as a substitute for fixed wiring of a structure.
  - 13.1.2** Attached to building surfaces.
  - 13.1.3** Routed through holes in walls, ceilings, or floors; or through doorways, windows, or similar openings.
  - 13.1.4** Concealed behind building walls, ceilings, or floors.
  - 13.1.5** Wired with a plug or connector that does not have dead-front construction or strain relief. “Dead-front construction” is defined as electrical equipment built so that it is “without live parts exposed to a person on the operations side of the equipment.”
  - 13.1.6** Placed where they could present a trip or fall hazard.
  - 13.1.7** Used when the cord insulation is damaged, cracked, or spliced; or when the ground pin is missing from the end of the male cord plug.
  - 13.1.8** Installed in raceways, unless specifically allowed by NEC provisions covering electrical raceways.
  - 13.1.9** Except for the temporary wiring provisions of NEC Article 305, the NEC does not allow the cord-and-plug connection of equipment to be energized from extension cords. Extension cords are not legal substitutes for the fixed wiring of a structure such as a receptacle outlet.
- 13.2** Flexible cord and cable, attachment plugs, and receptacles must be of the proper type, size, and voltage and current rating for the intended application.
- 13.3** Branch circuits that feed cord-and-plug connected equipment must be designed in accordance with NEC Article 210, have overcurrent protection in accordance with NEC Article 240, and be properly grounded in accordance with NEC Article 250.
- 13.4** All cord-and plug-connected equipment must be grounded with a correctly sized and identified equipment grounding conductor that is an integral part of the ac power cord or cable. Exception: Listed equipment that is protected by a double insulation system or its equivalent.
- 13.5** A suitable guard or cover must protect the interface between attachment plug and receptacle from intrusion process waste or other foreign material.
- 13.6** It is Hilscher-Clarke’s policy to allow cord and plug connection of equipment that operates at 250 V or less and has a maximum circuit rating of 30 A. Any equipment operating at higher voltages or currents should be permanently connected.

## 14.0 Vehicular & Mechanical Equipment Near Overhead Power Lines

- 14.1** Overhead power lines will be de-energized and grounded before any work is performed by any vehicle or mechanical equipment near the energized overhead power lines. If the overhead lines can not be de-energized, then the vehicle or mechanical equipment will be operated so that a clearance of 10 feet is maintained.
- 14.2** If the voltage of the overhead line exceeds 50 kV, the distance will be increased 4 inches for every 10 kV increase in power. If lines are protected with properly rated insulating devices, the distance may be decreased.
- 14.3** If the equipment is an aerial lift insulated for the voltage involved and if the work is performed by a Qualified Person, the clearance may be reduced to a distance given in the following chart:

<b>Approach Distances for Qualified Employees Alternating Current</b>	
<b>Voltage Range (phase to phase)</b>	<b>Minimum Approach Distance</b>
300 V and less	Avoid Contact
Over 300V, but less than 750V	1 ft. 1 in. (30.5 cm)
Over 750V, but less than 2kV	1 ft. 6 in. (46 cm)
Over 2kV, but less than 15kV	2 ft. 0 in. (61 cm)
Over 15kV, but less than 37kV	3 ft. 0 in. (91 cm)
Over 37kV, but less than 87.5kV	3 ft. 6 in. (107 cm)
Over 87.5kV, but less than 121kV	4 ft. 0 in. (122 cm)
Over 121kV, but less than 140kV	4 ft. 6 in. (137 cm)

- 14.4** If protective measures such as guarding or isolation are provided, these measures must protect the employee from contacting such lines directly with any part of the body or indirectly through conductive materials, tools, or equipment.
- 14.5** Employees on the ground or in the vicinity of overhead lines will be instructed to remain clear of the equipment or any other source of energized equipment unless using properly rated Personal Protective Equipment.

## 15.0 Illumination

Lighting, or lack of lighting, can contribute to accidents and to visual strain. Employees and the general public need to see what they are doing and where they are going. We have established the following guidelines and procedures as a way of ensuring that Hilscher-Clarke's worksites will be adequately lighted to minimize accidents. Where poor lighting exists or there is inadequate lighting for the job tasks, Hilscher-Clarke will provide sufficient lighting for the task.

### 15.1 Definitions:

**15.1.1 Illumination** – Light falling on a surface measured in *foot candles*;

**15.1.2 Luminance** – Light emitted or reflected from a surface unit area measured in foot/lambert.

**15.1.3 Reflectance** – Portion of arriving light on a surface that is reflected, measured in percent.

**15.2 Training** – All employees will be trained to recognize improper and inadequate lighting in their workplaces. Employees will be trained at the time of their initial employment or assignment.

**15.3 Light Sources** are daylight and artificial light. The types of artificial light at Hilscher-Clarke's jobsites include:

- Incandescent;
- Fluorescent;
- High intensity discharge (mercury and sodium vapor).

Each type of artificial light provides a different spectrum of wavelengths and is used at Hilscher-Clarke based on lighting needs.

**15.4** Lighting is classified as:

**15.4.1 General** – General lighting provides lighting to a large area.

**15.4.2 Supplementary** – A form of supplementary lighting is task lighting. Task lighting provides additional lighting for a particular task or activity.

**15.5 Hazards** – The major hazards associated with lighting include:

**15.5.1 Illumination Levels** – There can either be too little or too much light. If there is too little light, employees or the public cannot see well. This could result in an error occurring because a dangerous situation may not be recognized with a corresponding decrease in an individual's reaction time.

- Extremely bright light can injure receptor cells in the eye. Also, extremely bright light can cause afterimages that can obscure an individual's visual field until their receptor cells can recover. (The afterimage from a camera flashbulb or similar bright light is a common example.) Until an individual can recover from a bright light, the bright light may interfere with one's ability to detect an object.

**15.5.2 Changes in Illumination Levels** interfere with the ability of the eye to adjust quickly enough to permit seeing without error. Examples of changing light levels are the transition from bright outdoor light to dark interiors or from a bright area of a building to a dark one. Another example is looking at a brightly lighted task, then moving the eye to a location that is darker.

## 15.0 Illumination

**15.5.3 Glare** is the presence of a bright light in the visual field. Direct glare occurs when the light in the visual field is a source light. An example of direct glare is the headlights of an oncoming car at night. Reflected glare occurs when a bright light reflects from a surface. Glare can lead to errors in perception and detection that result in accidents and may produce afterimages or delay visibility due to adaptation.

**15.5.4 Luminous Contrast** refers to the changing light levels of an environment. For example, one may look at work on a desk that has a certain illumination. Shifting the eyes to a wall presents a much darker or lighter level of illumination. When there is too much difference between the two surfaces, the eyes have difficulty adapting, which may lead to visual errors.

**15.6 Recommended Illumination Levels** – Section 15.6.1 presents minimum illumination intensities for construction areas, ramps, runways, corridors, offices, shops, and storage areas.

**15.6.1** The values below should be used as minimum guidelines. Actual environmental conditions and lighting needs may dictate higher illumination levels. However, higher illumination levels have to be balanced against the hazards of that lighting level (see section 15.5).

<b>Minimum Illumination Intensities</b>	
<b>Area of Operation or Task</b>	<b>Foot -Candles</b>
General construction area lighting.	<b>10</b>
General construction areas, concrete placement, excavation and waste areas, access ways, active storage areas, loading platforms, refueling, and field maintenance area.	<b>3</b>
Indoors: warehouses, corridors, hallways, and exit ways.	<b>20</b>
Tunnels, shafts, and general underground work areas: (Exception: minimum of 10 foot-candles is required at tunnel and shaft heading during drilling, mucking, and scaling. Bureau of Mines approved cap lights shall be acceptable for use in the tunnel heading).	<b>5</b>
General construction plant and shops (e.g., batch plants, screening plants, mechanical and electrical equipment rooms, barracks or living quarters, locker or dressing rooms, mess halls, and indoor toilets and workrooms).	<b>30</b>
First Aid stations, infirmaries, and offices.	<b>100</b>
Working with very small sized objects.	<b>200</b>
Working with very small sized objects over a prolonged period.	<b>200-500</b>
Performance of very prolonged and exacting tasks.	<b>500-1000</b>

Illumination is measured in foot-candles. An illumination meter is a piece of equipment that measures illumination of any specified location. This instrument will be used to quantify the work-sites lighting area deficiencies.

## 15.0 Illumination (cont.)

- 15.7 Illumination for Night-Time Construction** usually consist of tower lights and machine lights.
- 15.7.1 Tower Lights** – consist of mercury vapor, metal halide, high pressure sodium or low pressure sodium fixtures mounted on a tower approximately 30 feet in height. The lights should be aimed and positioned to illuminate the area for construction work with no disabling glare to employees or if applicable, passing motorists.
- 15.7.2 Machine Lights** – are mercury vapor, metal halide, high pressure sodium, or low pressure sodium. They are typically conventional fixtures mounted on supports attached to the construction machine at a height of approximately 13 feet above ground. Machine lights are installed in addition to conventional automotive type head lights.
- 15.7.3 Night-time** construction lighting must meet all the specifications, provide adequate lighting for the work being performed, and sufficiently identify the work zone to other employees and/or motorists. Night-time illumination must be approved by the Safety Manager.
- 15.8** The Site Supervisor will identify areas with inadequate or improper illumination through facility and jobsite audits. They will also communicate these illumination deficiencies to the Safety Manager.
- 15.9** Employees shall comply with all applicable guidelines contained in this section. Additionally, they shall report any unsafe illumination conditions to the Supervisor.
- 15.10** The Safety Manager will provide prompt assistance and technical guidance to the Site Supervisor and Affected Employees on illumination problems in the workplace. The Safety Manager will also provide a Qualified Engineer for technical guidance on night-time illumination problems at the work site.

## 16.0 Confined Space Entry

**Reference Appendix G of this program, and Hilscher-Clarke's Confined Space Program.**

- 16.1** The OSHA confined-spaces rule, 29 CFR 1910.146, establishes the definition for “permit-required confined spaces,” as a confined space that:
- 16.1.1** Contains or has a potential to contain a hazardous atmosphere;
  - 16.1.2** Contains a material that has the potential for engulfing an entrant;
  - 16.1.3** Has restricted entry or exit;
  - 16.1.4** Requires the use of hands or contortion of the body to enter or exit;
  - 16.1.5** Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section, or;
  - 16.1.6** Contains any other recognized serious safety or health hazard.
- 16.2** OSHA also indicates that some confined spaces may be excluded from the definition. Those areas are termed “non-permit confined spaces,” which means a confined space which does not contain, or with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.
- 16.3** *In recognition of these hazards, Hilscher-Clarke has developed a Confined Spaces and Permit Required Confined Spaces Program. Please refer to this document for guidelines and operating procedures in reference to any electrical work to be performed within a confined space and/or a permit required confined space.*

## 17.0 Clearance Around Electrical Equipment

- 17.1** Maintain clearance space around power and lighting circuit breaker panels, motor controllers, and other electrical equipment. This clearance space ensures safe access for personnel who inspect, adjust, maintain, or modify energized equipment.
- 17.2** For equipment operating at 600 V (nominal) or less, the minimum required clearance is an unobstructed space 76 cm (30 in.) wide, 91 cm (36 in.) deep, and 198 cm (78 in.) high (measured from the floor). Some installations may require greater distances.
- 17.3** Clearance space must not be used for storage or occupied by workbenches, desks, etc.
- 17.4** Clearance space is not required for wall switches, disconnect switches, Ramos-box-type combination multiple circuit breaker/outlet receptacle assemblies, and similar electrical equipment if:
  - 17.4.1** Equipment can be positively de-energized for inspection, adjustment, or maintenance using approved lockout/tagout procedures , and;
  - 17.4.2** Readily accessible space is maintained around such equipment at all times.
- 17.5** Readily accessible space enables an employee to quickly and effectively operate any circuit breaker handle or switch toggle, insert or remove any connector, or perform any similar act associated with the equipment without moving apparatus, climbing, or resorting to a ladder.
- 17.6** Some existing buildings, because of their age, have power and lighting circuit breaker panels that were installed prior to present working clearance codes and regulations. These installations may be acceptable, but must be evaluated to determine whether additional safety measures are necessary. This should be discussed with the Job Superintendent before any work begins.

# Appendix

# Electricity And Conductivity

## Electricity's Pathways

Electricity always follows the easiest path to the ground. It will travel there through any conductive material, such as water, metal, some chemical solutions and the human body. If you come into contact with live electrical parts or wires - either through direct touch or via a conductor - electric current will pass through your body on its way to the ground, delivering a shock and possibly severe burns or death.

A complete circuit is necessary for electricity to flow through a conductor. A complete circuit is made when there's a source of electricity, a conductor and a consuming device such as a portable drill. Most electrical accidents occur when workers come into contact with electrical current - either directly or through conductive materials or equipment.



**"Working safely around electricity requires a basic understanding of conductive materials, the hazards they present and how these hazards can be controlled."**

- Avoid using electrical equipment when your hands are wet or sweaty.
- Lockout/tagout procedures enforce the shutoff of all energized parts during equipment maintenance and repairs to protect workers from accidental contact with live electrical parts.
- If you must work with energized parts and lockout/tagout isn't possible, always use protective equipment, such as rubber boots, sleeves, blankets and mats and nonconducting tools rated for the voltage of the parts.
- Never patch worn or frayed extension cords with tape.

- Never carry equipment by the cord.
- When using extension cords, never fasten them with staples, hang them from nails, suspend them by wire or otherwise damage the cord's insulation.
- Make sure insulation is adequate for the voltage, undamaged, clean and dry.

## Protect Yourself

- Whenever you work around electrical equipment, always identify all conductors that could come in contact with electricity. Metal tools, pipes, ladders, steel wool, some chemical solutions and water are a few of the common conductors.
- Avoid wearing metal jewelry and headgear when working around energized parts or equipment.

**How much electricity does it take to hurt you?**

The answer is "not much." In fact, the amount of current needed to light an ordinary 60-watt light bulb is five times what can kill a person. What this means is that all electrical equipment on work sites is potentially deadly.

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# Working Near Overhead Power Lines

A worker who climbs onto a tall truck bed to unfasten a load can be electrocuted instantly if he or she contacts a nearby power line. And a worker who positions a crane or dump truck beneath a power line risks electrocution when the boom or bed is raised.

Accidents involving overhead power lines are serious and usually result in death. They're typically caused by carelessness and can be prevented.

## If You Work Beneath Power Lines

- ▶ Estimate clearance between power lines and the highest point of your equipment.
- ▶ Carefully survey the scene to identify any overhead hazards.
- ▶ Keep yourself and your equipment at least 10 feet from power lines.
- ▶ Have the power company install protective barriers or de-energize the lines.
- ▶ Make sure workers on the ground don't touch vehicles and other equipment near the power lines, and make sure workers aren't near the grounding location.
- ▶ Be extra cautious when handling long conductive materials, such as pipes and metal rods.
- ▶ Use ladders with nonconductive rails.
- ▶ Wear protective equipment, such as nonconductive headgear and rubber sleeves, gloves and boots.
- ▶ Never store materials, supplies, or equipment underneath or within 10 feet of overhead power lines.
- ▶ If a live power line hits your vehicle, stay inside; if there's a fire, jump out - with feet together - as far from the vehicle as you can. Avoid touching the vehicle and the ground at the same time.
- ▶ If a live power line falls, stay away from it and call for help.



# ARCING: WHAT YOU SHOULD KNOW

When electricity flows through the air from one pole of an electric circuit to another, or jumps from its source to ground without flowing through a desired circuit, it is said to arc. This phenomenon is often accompanied by visible flashes of light and crackling noise. Lightning and static electricity shocks are well-known examples of arcing.

## Hazards

An arc occurs when faulty wiring, a break in cord insulation or a short circuit causes electric current to leap out in a spark. In electrical generation, arcing is usually undesirable because an arc sends all electricity to ground without putting it to a practical use. If the current is great enough, an arc can cause shock or burns or start a fire. In environments that contain explosive gases, vapors or combustible dusts, even low-energy arcs can cause violent explosions. Extremely high-energy arcs can damage equipment and send fragments flying.



## Preventing Arcs

- ▶ Insulation - the material that covers electrical wires and encloses live elements on some equipment - must be appropriate for the voltage and must remain undamaged, clean and dry.
- ▶ Inspect cord and equipment insulation before each use.
- ▶ If a cord is frayed or a connection is loose, replace it.
- ▶ Never use a cord that has the ground prong missing.
- ▶ Keep power cords far from cutting edges.
- ▶ Don't step on or run over power cords with equipment or vehicles.
- ▶ Grasp the plug, not the cord, when unplugging equipment.
- ▶ Stay within cord voltage requirements for tools and equipment.
- ▶ If you must use electrical equipment in wet areas, use double-insulated tools.
- ▶ A ground fault interrupter (GFI) must be used. Make sure your power cord isn't lying in water or on a damp surface.
- ▶ Keep your hands and body dry.
- ▶ Avoid standing in or near water.
- ▶ Inspect your equipment before use and report any loose or broken wiring or connections.

## What is Lockout/Tagout?

To physically neutralize all energies in a piece of equipment before beginning any maintenance or repair work. Lockout generally involves:

- Stopping all energy flows (for example by turning off switches, or valves on supply lines.)
- Locking switches and valves.
- Securing the machine, device, or power transmission line in a de-energized state (for example, by applying blocks or blanks, or bleeding hydraulic or pneumatic pressure from lines.)

### You Need Special Training and Authorization to Perform Lockout/Tagout:

Lockout/tagout is performed only by authorized employees who are trained to:

Recognize hazardous energy sources and their type and amount of energy

Isolate and control energy to prevent accidents.

Perform OSHA's specific, required lockout/tagout steps.

Affected employees work with powered equipment but aren't authorized to apply or remove locks and tags. They must know:

Why Lockout/tagout is important and how it works.

The requirement to lock/tag out equipment before performing repairs or service.

The importance of not trying to remove or work around locks or tags.

Other Employees aren't involved with lockout/tagout, but should still understand:

Lockout/tagout's basic procedures.

- The importance of not trying to restart locked or tagged equipment.

### OSHA Sets Standards For Lockout/Tagout Locks & Tags

These locks and tags must be:

- Used only for lockout/tagout.
- Durable enough for the job's length and conditions (i.e., temperature, humidity).
- Standardized so all facility lockout/tagout locks and tags are the same color, shape, and size.
- Strong enough to be removed only by heavy force or tools like bolt cutters.
- Identified with the name of the employee who installs and removes it.

Tags must also be:

- Legible, even if they get dirty or damp.
- Attached by hand with nylon cable ties or other self-locking means that
  - Can't be reused;
  - Need at least 50 pounds of strength to remove.

The electrical, mechanical, hydraulic, or pneumatic energy that powers equipment or the energy stored in springs, steam, or pressurized air or liquids can be dangerous. Working on equipment you believe has been shut-off can cause serious injury if there's an unexpected:

- Restart of power;
- Release of energy stored in springs, steam, or pressurized air or liquid;
- Movement of parts.

Unexpected Energization could cut, hit, crush, or even kill a person who's working on the machine to perform tasks like:

- Repairs or maintenance;
- Cleaning;
- Checking mechanical or operational problems.

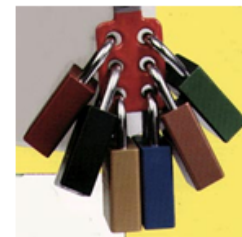
### Take Action To Prevent Accidental Energization

Before working on powered equipment, you must:

- Turn it off, and lock out the power;
- Release, drain, and lock out any stored energy.

### Lockout Prevents Accidental Energization

- A lock is placed on the machine's energy control switch, circuit breaker, etc.
- The lock secures the device in an "off" position so it can't be started up accidentally.



What is LOTO.ppt

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# What to do About Electrical Shocks and

An electrical shock can severely burn soft tissue, stun muscles and nerves and stop the life supporting systems of the human body such as the heart and pulmonary functions. Quick, decisive action to electrical emergencies saves lives. But a haphazard response will do more harm than good. Take a few moments to review and become familiar with the following procedures. By following the response procedures we have outlined below, hopefully it will make it easier for you to think clearly and act quickly if an electrical shock or burn occurs to a fellow worker.



## Responding To Electrical Shock

- ▶ To protect yourself from shock, turn off the power before touching the victim or equipment.
- ▶ If you can't turn off the power, use a non-conducting tool, such as a dry wooden stick, to move the person; then call for help.
- ▶ Make sure you don't complete a circuit between the source and the ground.
- ▶ If the victim is touching a power line, stay clear and call for help.
- ▶ Before giving any treatment, check the victim's breathing and pulse.
- ▶ If breathing has stopped, give artificial respiration.
- ▶ If you don't detect a heartbeat, start CPR, if you've been trained to do so.
- ▶ Continue CPR until medical help arrives or until the victim begins to breathe on his or her own.

## Responding To Burns

- ▶ Burns suffered in electrical accidents may affect the skin, muscles, organs and bones.
- ▶ The first hour is crucial for treating burns
- ▶ Look for two wounds: an entrance and exit burn.
- ▶ Treat minor burns to the skin with cool water, then cover it with a clean dry cloth.
- ▶ Never use ointment or ice on a burn.
- ▶ Serious burns require immediate medical attention.
- ▶ If the victim goes into shock, keep him or her lying down with feet elevated until help arrives.
- ▶ Never try to pull charred clothing off of burned skin.

## Think Before You Act!

*No matter what type of electrical emergency confronts you, always stop to notice what's going on and think about a safe plan of action. Although your instinct may be to rush in and grab the person who's being shocked, that type of action could cost you your life.*

## How Shock Happens

Electricity follows the easiest path to the ground. It will flow through any conductive material, such as water, metal, certain chemical solutions and the human body. If you come into contact with electricity while you're in contact with the ground, you become part of an electrical circuit and current passes through your body, causing a shock. Even a small shock can kill you if it passes through your heart and lungs. Deep internal burns can also occur.

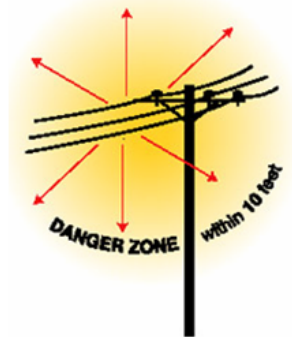
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## Ladders & Power Lines

Ladders are essential in many jobs, particularly those involving construction and maintenance tasks. But frequently work areas also include electric lines, usually the drop lines from nearby utility poles, and sometimes even nearby overhead utility power lines. And these lines don't mix with ladders.

When participating in outdoor, overhead activities, take the following precautions:

- ▶ Keep all ladders and other tools in the **SAFE ZONE**, at least 10 feet from any power lines.



- ▶ Never count on a power line to be insulated, no matter what it looks like. Most utility power lines are not insulated.

## If You Must Work Near A Power Line

- ▶ Don't count on a wooden ladder to protect you. Wood will conduct electricity, as will wet, dirty and defective ladders of any kind. Fiberglass ladders are best, but even they are no guarantee of safety.
- ▶ Before you use a ladder, check the area carefully for power lines or other electrical equipment. Pick a safe route to carry the ladder to the work area, then carry it horizontally never upright. Put it up only where you have to work. Always make sure that, if the ladder fell, it would not contact any power lines or other electrical equipment.
- ▶ When you're on a ladder, balance and control aren't at their best. Be careful with pipes, conduits, gutters, antennas and other long objects. Never hold them in a position where they could fall onto a power line. Remember that distances are deceiving from the top of a ladder and make sure you don't lift an antenna or other object up into an overhead line.

## Use Caution

If a fellow worker touches a downed line, or is handling equipment that contacts a power line, remember that any rescue attempt also places you in danger of receiving an electrical shock or injury. The farther away you stay from the equipment, the line and the person, the better your chances of not being injured yourself. Instead of attempting a rescue, call your local police and fire rescue for help.

If you have to rescue a person in contact with a power line, **NEVER** use your hands or any conductive material!

## Checking Ladders

### IS IT SAFE ENOUGH?

Run this quick check on any ladder you're thinking of buying, hiring or using.

- ▶ General condition sound? (clean & dry, free from wet paint, mud, oil etc).
- ▶ No cracks?
- ▶ No rungs missing or loose?
- ▶ Not painted? Ladders should never be painted, as this could hide dangerous defects from view.
- ▶ No stiles - damaged or bent? Stiles are the outside upright on a ladder.
- ▶ No warping or splitting? (wood)
- ▶ No corrosion? (metal)
- ▶ No sharp edges or dents? (metal)
- ▶ No rungs bent? (metal)
- ▶ Footpads okay?

Caps/rubber fittings okay?

- ▶ All metal ladders should have slip-resistant rubber or plastic feet.

Damaged ladders need professional repairing - or replacing.

## Look Up & Live

Always remember to look up and around when you work near overhead power lines.

When there are trees around, remember; tree branches can obstruct your view of power lines.

Ladders & Electric Lines © June 2002 Safety Resources Co. of Ohio, Inc.



## NFPA 70E Arc Flash Protection

The National Fire Protection Association (NFPA) published the seventh edition of the 70E Standard for Electrical Safety Requirements for Employee Workplaces in February of 2004. This edition contains an introduction, 4 chapters, 13 annexes, and has many significant changes from the sixth edition:

- Total reorganization into the NEC format
- Chapter 2 was moved to become chapter 1
- Chapter 3 became chapter 2
- Chapter 4 became chapter 3
- Chapter 1 became chapter 4.
- The issue of multi-employer relationships (110.4) is addressed

The addition of multi-employer relationships now makes the employer (in this case Hilscher-Clarke and the Customer whenever acting in the construction management or general contractor role) liable whenever outside contractors are engaged in activities covered by the scope and application of this standard. The employer and contractor must inform each other of existing hazards, personal protective equipment/clothing requirements, safe work practices, and emergency evacuation procedures applicable to the work to be performed. This coordination shall include a meeting and documentation.

NFPA 70E covers the full range of electrical safety issues, including safety related work practices, maintenance, special equipment requirements, and installation. It focuses on protecting people and identifies requirements that are considered necessary to provide a workplace that is free of electrical hazards. OSHA bases its electrical safety mandates, found in Subpart S part 1910 and Subpart K part 1926, on the comprehensive information found in NFPA 70E. NFPA 70E is recognized as the tool that illustrates how an employer might comply with these OSHA standards. The relationship between the OSHA regulations and NFPA 70E can be described as OSHA is the "shall" and NFPA 70E the "how."

**OSHA mandates that all services to electrical equipment be done in a de-energized state.** Working live can only be under special circumstances. If it is necessary to work live (>50 volts to ground), the regulations outlined in NFPA 70E, Article 130 should be used as a tool to comply with OSHA mandates Subpart S part 1910.333(a)(1). Highlights of this article include:

- Shock hazard analysis (paragraph 130.2): Determines the voltage to which personnel will be exposed, boundary requirements, and PPE necessary. Table 130.2(C) is used to determine boundary distances.
- Flash hazard analysis (paragraph 130.3): Determines the flash protection boundary and PPE needed within that boundary. The flash protection boundary is determined by methods found in 130.3(A) or Annex D of the standard. Protective clothing is determined by using tables 130.7(C)(9)(a), 130.7(C)(10), and 130.7(C)(11).

Remember, OSHA only allows work on live electrical parts under two special circumstances: (1) when continuity of service is required, and (2) when de-energizing equipment would create additional hazards. In all other cases, lockout/tagout is the law.

Employers are also responsible for complying with the 2002 NEC 110.16 labeling requirements. This requires all switchboards, panel boards, industrial control panels, and motor control centers to be field marked. Any equipment installed after 2002 needs to be labeled. For equipment installed before 2002, labeling must be applied if ANY modifications or upgrades take place. Some of the labels listed below require boundary distances calculated in Article 130 of the standard. Examples of labels that meet this requirement are (see following page):

## NFPA 70E Arc Flash Protection (cont.)



## Personal Protective Equipment

Employees working in areas where there are electrical hazards are to be provided with, and required to use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.

- An employee working within the flash protection boundary must wear protective clothing and other protective equipment.
- Protective equipment must be maintained in a safe, reliable condition and conform to the standards in Table 130.7(c)(8); follows this appendix.
- The protective equipment must be inspected visually before each use.
- Employees must wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from electrical explosion.
- Face shields must have an arc rating suitable for the arc flash exposure and the use of face shields without an arc rating is prohibited. Face shields with energy absorbing formulations:
  - Can provide higher levels of protection from the radiant energy of an arc flash.
  - Are timed and can reduce visual acuity.
  - Additional illumination of the task area may be necessary when these types of arc protective face shields are used.
  - 130.6(c) prohibits employee entry into spaces containing live parts unless illumination is provided that enables the employee(s) to perform work safely (see page 37 of this policy and procedure).
- Employees must wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes or from flying objects resulting from electrical explosion.
  - Eye protection must always be worn under face shields or hoods.
- Employees must wear rubber insulating gloves where there is danger of hand and arm injury from electric shock due to contact with live parts.
- Hand and arm protection must be worn where there is possible exposure to arc flash burn.
- Where insulating rubber gloves are used for shock protection, leather protectors shall be worn over the rubber gloves.
- Leather or FR gloves must be worn where required for arc flash protection
  - Insulating rubber gloves and gloves made from layers of flame resistant material provide hand protection against the arc flash hazard.
  - Heavy-duty leather gloves provide protection suitable up to Hazard/Risk Category 2.
  - Leather protectors worn over insulating rubber gloves provide additional arc-flash protection for the hands.
- Arm protection is required to be accomplished by apparel described in Section 130.7(C)(5) which contains the provisions for body protection.

## **NFPA 70E Arc Flash Protection (cont.)**

### **Personal Protective Equipment**

- Where insulated footwear is used as protection against step and touch potential, dielectric overshoes are required.
- Heavy-duty leather work shoes provide some arc flash protection to the feet; they must be used in all tasks in Hazard/Risk Category 2, and higher.

When flame-resistant (FR) clothing is worn to protect an employee, it is required to cover all ignitable clothing.

Each FR garment is assigned an ATPV rating by the manufacturer. The ATPV value represents the amount of incident energy that would cause the onset of second-degree burns. It also signifies the amount of protection the clothing affords when an electrical arc comes in contact with the fabric. Most of the industry falls into either Category 1 or 2 protection. Most uniforms already meet Category 1 or 2 requirements, but people who fall into this category typically are not covered by this standard. The employees addressed by this standard fall into Category 3 and 4. The garments must also be designed to withstand a cleaning process to remove soils and then be returned to service without damage to the fabric. The label on the garment must contain the following information: tracking ID number, meet ASTM spec F1506, name of manufacturer, size and care instructions, ATPV rating, and must meet ASTM spec f1506.

### **Other Protective Equipment**

Employees must use insulated tools and/or handling equipment when working inside the limited approach boundary of exposed live parts where tools or handling equipment might make accidental contact. The insulated tools must be:

- Rated for the voltages on which they are used.
- Be designed and constructed for the environment to which they are exposed and the manner in which they are used.
- Be protected from damage to the insulating material.

Hilscher-Clarke shall:

- Demonstrate why equipment must worked on or near in an energized state.
- Require employees to use insulated tools when working on or near equipment that is not placed in an electrically safe work condition.

### **Other Protective Equipment**

Additional types of equipment that NFPA70E address:

- Fuse or Fuse Holding Equipment
- Ropes and Handlines
- Fiberglass-Reinforced Plastic Rods
- Portable Ladders
- Protective Shields
- Rubber Insulating Equipment
- Voltage Rated Plastic Guard Equipment
- Physical or Mechanical Barriers

**Table 130.7(C)(10) Protective Clothing and Personal Protective Equipment (PPE) Matrix**

Protective Clothing and Equipment Hazard/Risk Category Number	Protective Systems for Hazard/Risk Category					
	-1 (Note 3)	0	1	2	3	4
<b>Non-melting (according to ASTM F 1506-00) or Untreated Natural Fiber</b>						
a. T-shirt (short-sleeve)	X			X	X	X
b. Shirt (long-sleeve)		X				
c. Pants (long)	X	X	X (Note 4)	X (Note 6)	X	X
<b>FR Clothing (Note 1)</b>						
a. Long-sleeve shirt			X	X	X (Note 9)	X
b. Pants			X (Note 4)	X (Note 6)	X (Note 9)	X
c. Coverall			X (Note 5)	X (Note 7)	X (Note 9)	X (Note 9)
d. Jacket, parka, or rainwear			AN	AN	AN	AN
<b>FR Protective Equipment</b>						
a. Flash suit jacket (multilayer)						X
b. Flash suit pants (multilayer)						X
c. Head protection						
1. Hard hat			X	X	X	X
2. FR hard hat liner					AR	AR
d. Eye protection						
1. Safety glasses	X	X	X	AL	AL	AL
2. Safety goggles				AL	AL	AL
e. Face and head area protection						
1. Arc-rated face shield, or flash suit hood				X (Note 8)		
2. Flash suit hood					X	X
3. Hearing protection (ear canal inserts)				X (Note 8)	X	X
f. Hand protection						
Leather gloves (Note 2)			AN	X	X	X
g. Foot protection						
Leather work shoes			AN	X	X	X

AN = As needed

AL = Select one in group

AR = As required

X = Minimum required

Notes:

1. See Table 130.7(C)(11). Arc rating for a garment is expressed in cal/cm<sup>2</sup>.

2. If voltage-rated gloves are required, the leather protectors worn external to the rubber gloves satisfy the requirement.

3. Hazard/Risk Category Number "-1" is only defined if determined by Notes 3 or 6 of Table 130.7(C)(9)

4. Regular weight (minimum 12 oz/yd<sup>2</sup> fabric weight), untreated, denim cotton blue jeans are acceptable lieu of FR pants. The FR pants used for Hazard/Risk Category 1 shall have a minimum arc rating of 4.

5. Alternate is to use FR coveralls (minimum arc rating of 4) instead of FR shirt and FR pants.

6. If the FR pants have a minimum arc rating of 8, long pants of non-melting or untreated natural fiber not required beneath the FR pants.

7. Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or untreated natural fiber pants and T-shirt.

8. A faceshield with a minimum arc rating of 8, with wrap-around guarding to protect not only the face, also the forehead, ears, and neck (or, alternatively, a flash suit hood), is required.

9. Alternate is to use two sets of FR coveralls (the inner with a minimum arc rating of 4 and outer cover with a minimum arc rating of 5) over non-melting or untreated natural fiber clothing, instead of FR cover over FR shirt and FR pants over non-melting or untreated natural fiber clothing.