

ELECTRICAL SAFETY



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1. PURPOSE

Although many forms of energy sources exist, electricity has become an essential requirement for everyday business operation as we know it. However, as a source of power, electricity tends to be accepted without much thought to the hazards that can be encountered by the average worker. Perhaps because it has become so commonplace and such a familiar part of our daily wo routine, it is often handled without the respect it deserves.

This program has been written and established by **H-2 Enterprises, LLC (H2E)** to minimize potential employee exposures to serious workplace hazards such as electrocution, shock, arc-blast, fires or explosions from electrical equipment, lighting, motors, machines, appliances, switches, controls, enclosures, instrumentation, etc.

At **H2E**, only trained, competent and authorized personnel will be allowed to energize or de-energize electrical circuits or perform work of an electrical nature on electrically driven equipment.

These persons will perform safe-work practices and procedures to prevent electrical shock or other injuries resulting from either direct or indirect electrical contact. They will also use special testing equipment and techniques, personal protective equipment, insulating and shielding materials, and insulated tools while working on circuits or equipment that are or can be energized.

Qualified personnel have been trained in and are familiar with the following items:

- Proper use and maintenance of electrical tools and equipment.
- Preventative measures to be taken to eliminate or minimize electrical hazards.
- Proper use and maintenance of personal protective equipment that will be used to minimize exposure to electrical hazards.
- Steps to take in case of an injury to oneself or to a coworker that involves electrical hazards.
- The skills and techniques necessary to distinguish exposed live electrical parts from other parts of electrical equipment.
- The skills and techniques necessary to determine the nominal voltage of exposed live electrical parts.
- The clearance distances specified in 1910.333c (these are listed in a forwarded section on authorized workers) and the corresponding voltages to which the qualified person may be exposed.
- Recognition of hazardous energy sources (electrical, mechanical, hydraulic, pneumatic, thermal, spring-loaded, etc.)

- Methods and means necessary to control and isolate energy.

Documentation of this training is maintained by the Director, HSE and located in the Safety Training Files.

2. GENERAL REQUIREMENTS

a. Examination, Installation and Use of Equipment

- i. Electrical equipment shall be maintained free from recognized hazards that are likely to cause death or serious physical harm to employees. Frequent and periodic inspections by Management, trained personnel, and operating employees will be performed on a routine basis to establish and maintain safe working electrical conditions. Items for inspection should include:
 - Identifying the work purpose and suitable electrical equipment needed (determined by classification type, size, voltage and current capacity).
 - Check for manufacturer's nameplate/label/descriptive markings; they must be legible and unaffected by environmental conditions.
 - Determine mechanical strength and durability of enclosure parts.
 - Observe heating effects under conditions of use.
 - Observe any arcing effects under conditions of use.
 - Insulation materials must be intact with no cuts, breaks or incorrect splices.
 - Disconnecting/disengaging means are identified, intact and functioning.

b. Identification of Disconnecting Means and Circuits

- i. Each disconnecting means (breaker) for motors and appliances, as well as each service, feeder and branch circuit at its disconnecting means or over-current device, shall be legibly marked to indicate its purpose, unless located and arranged so the purpose is evident. These markings shall be of sufficient durability to withstand the environment involved.

c. Over-current Protection

- i. In the event an overload device or circuit breaker trips in a distribution panel or switch-gear room, the circuit breaker shall not be reset or returned to the "ON" position until the cause of the circuit breaker operation has been determined by qualified electrical personnel, or assigned host-facility personnel. Once the circuit has been tested and it is determined that it can be safely re-energized, then the circuit breaker may be reset and returned to the "ON" position, restoring electrical power to the circuit it was supplying. No materials may be stored inside or on any electrical cabinet.

d. Protection of Conductors and Equipment

- i. Access to a distribution panel, breaker box, switch gear, etc., is to be secured, protected, signed or warned against accidental contact by personnel not trained, or qualified to be near live exposed electrical parts (any live part of electrical equipment operating at 50 volts or more). In locations where electric equipment would be exposed to physical damage, strong enclosures/guards shall be arranged to prevent damage. Clear workspace must be provided, at least 6 feet 6 inches high and 3 feet wide.

e. Grounding

- i. A potential shock hazard exists when no third wire “grounding conductor” is used. If a fault occurs, most of the current will follow the path of least resistance, which is usually through a worker’s hands or feet and then back to ground. To prevent this, all exposed non-current-carrying metal parts of cord and plug-connected equipment must be grounded by an approved system of double insulation, (unless this equipment is supplied through an isolating transformer with an ungrounded secondary of not over 50 volts).

f. Electrical Continuity

- i. Metal raceways, cable armor and other metal enclosures for conductors shall be securely and metallically joined together into a continuous conductor and shall be so connected to all boxes, fittings and cabinets to provide effective electrical continuity. The knockouts in cabinets, boxes and fittings should be removed only if conductors are to be run through them. However, if a knockout is missing or if there is another hole in the box, the hole or opening must be closed. All interior wiring systems in metal raceways or enclosures shall be grounded always.

g. Approved Covers and Canopies

- i. All pull boxes, junction boxes and fittings shall be provided with tight-fitting covers approved for the purpose. If metal covers are used, they shall be grounded. In completed installations, each outlet box shall have a cover, faceplate or fixture canopy. If flexible cord pendants pass through a box opening, they shall be provided with bushings on which the cords may bear.

h. General Illumination

- i. Lamps for general illumination shall be protected from accidental contact or breakage. Protection shall be provided by elevation of at least 7 feet from normal working surface or by a suitable fixture or lamp-holder with a guard. Employees may not enter spaces containing exposed energized parts unless illumination is if enables the employees to work safely. Protective shields, barriers or insulating materials will be provided as necessary for employee protection.

i. Portable Illumination

- i. Portable type hand-lamps (drop-cords) supplied through flexible cords shall be equipped with a handle of molded composition or other material approved for that purpose and a substantial guard shall be attached to the lamp-holder or handle always.

j. Flexible Cords and Cables

- i. Flexible cords and cables shall be protected from accidental damage. Sharp corners and projections shall be avoided. Where passing through doorways or other pinch points, flexible cords and cables shall be provided with padding or protection to avoid damage.

k. Hazardous (Classified) Locations

- i. There are no hazardous classified locations around electrically operated equipment at the H2E main shop location. However, these areas may have the potential to exist while our employees are performing contract service work at host-facility locations. In the event this occurrence is realized; our employees will follow all pertinent guidelines established in these classified locations by the facility owner/operator.

3. ELECTRICAL SAFETY RELATED WORK PRACTICES

Although electrical equipment may comply with the installation requirements, when authorized employees are working with electrical equipment, they must use safe work practices.

Prescribed distances must be maintained, avoiding the use of electrical equipment when the employee and/or equipment is wet, and performing lockout/tagout of equipment de-energized for maintenance. (See Lockout/Tagout Program located in this manual.)

Employees must always regard all wires as live and dangerous, even if de-energized, if their source has NOT been locked or tagged out.

Employees who face a risk of electrical shock will be trained and familiar with electrically related safety practices if their work brings them close enough to exposed parts of electrical circuits operating at 50 volts or more to ground. (Examples: Understand and respect LO/TO program; do not use electrical tools with wet hands or in wet locations; maintain prescribed safe distances; use safe conductive material handling, ladder use, housekeeping duties and conductive apparel, etc.

a. Working Under Overhead Lines

- i. If work is to be performed near overhead lines employees shall follow NEC standards. If protective measures are provided, such as guarding, isolating or insulating, these precautions shall prevent employees from bodily contacting such lines directly or indirectly.

b. Overhead Work for Unqualified Persons

- i. When an unqualified person is working near overhead lines, whether in an elevated position or on the ground, the person will not approach a

conductive object (an unguarded, energized line) closer than the following distances:

c. For voltages to ground 50kV or below - 10 feet

- i. For voltages to ground over 50 kV – 10 feet plus 4 inches for every 10kV over 50kV.

d. Overhead work for Qualified Persons

- i. When a qualified person is working near overhead lines, whether in an elevated position or on the ground, the person will not approach or take any conductive object, without an approved insulated handle, closer to exposed energized parts than the following distances:

Less than or equal to 300V	=	avoid contact
Greater than 300V but less than 750V	=	12 inches
Greater than 750V but less than 2kV	=	18 inches
Greater than 2kV but less than 15kV	=	2 feet
Greater than 15kV but less than 37kV	=	3 feet
Greater than 37kV but less than 87.5kV	=	3 feet 6 inches
Greater than 87.5kV but less than 121kV	=	4 feet
Greater than 121kV but less than 140Kv	=	4 feet 6 inches

e. Vehicular and Mechanical Equipment

- i. Any Company vehicle or mechanized equipment (man-lift or back- hoe) capable of having part of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 feet is maintained. If the voltage is higher than 50kV, the clearance shall be increased 4 inches for every 10kV over that voltage.

f. Bodily Contact with Conductive Materials

- i. Any conductive material or equipment that is in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed energized conductors or circuit parts. If long dimensional conductive objects (pipes, rods, ducts) must be handled around exposed live parts, work practices to include guarding, insulating or safe material handling techniques will be used to minimize the hazard.

g. Portable Ladder Use

- i. Any portable ladder used by an employee that could contact exposed energized parts shall have non-conductive side-rails (wood or fiberglass).

h. Wearing Conductive Articles

- i. Conductive articles of jewelry or clothing (watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread or metal headgear) may not be worn if they might contact exposed energized parts, unless they are made non-conductive by means of covering, wrapping or insulating.

i. Housekeeping Duties

- i. Employees may not perform housekeeping duties at proximity to exposed energized parts unless adequate safeguards (insulating equipment or barriers) are provided. Electrically conductive cleaning materials (steel wool, metalized cloth or silicon carbide) may not be used in proximity to energized parts unless procedures are followed which will prevent electrical contact.

j. Portable Electric Equipment Handling

- i. Portable equipment shall be handled in a manner that will not cause damage, i.e., do not use the flexible cord to raise and lower the equipment. These flexible cords cannot be stapled or hung in a fashion that would damage the outer jacket or insulation.

k. Portable Electric Equipment Visual Inspection

- i. Portable cord and plug connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects and for evidence of possible internal damage. If the equipment remains connected once it is put into place and is not exposed to damage, inspection is deferred until relocation occurs. To assure this inspection is completed and documented, the following program is being implemented in compliance with this regulation.

4. ASSURED GROUNDING CONDUCTOR PROGRAM

The purpose of this program is to assure all employees working on H2E job sites that all power tools, flexible cords and/or cord sets used by them will have an effective, working grounding conductor for electrical safety and shock protection. A copy of this written program shall be available at the job site for inspection or review by employees or a regulatory compliance agency. Qualified, trained, competent personnel will test all powered equipment, tools and cords in accordance with the following procedures:

a. Responsibility

- i. The Project Safety Coordinator is designated as the competent person assigned the responsibility of implementing this program.

b. Equipment

- i. The following cord-connected, electrically powered equipment shall not be available or permitted for employee use until the testing procedures described in this written program have been complete and documented:

Hand drill Motors, Vacuum Cleaners, Hoists, Extension Cords, Fans, Grinders, Wire Brushes

c. Testing Procedure

The assured electrical equipment grounding conductor test procedure will be as follows:

- i. All equipment-grounding conductors shall be tested with GFCI tester for continuity and shall be electrically continuous.
- ii. Each receptacle and attachment cap or plug shall be tested for correct attachment of the grounding conductor. The equipment-grounding conductor shall be connected to its proper terminal.
- iii. Testing frequency shall be as follows:
 - 1. Before first use.
 - 2. Before equipment or cord is returned to service following repairs
 - 3. Before equipment is used, if damage is witnessed or suspected.
 - 4. At intervals, not to exceed 6 months for fixed cords/receptacles not subject to damage.
 - 5. At intervals, not to exceed 3 months for all other cords and plug connected equipment.

d. Testing Identification

All cords and power tools shall have a color-coded, taped band approximately 12 inches from the tool or male cap end showing the last time the cord or tool was tested. The color-code is as follows:

January through March	=	RED
April through June	=	YELLOW
July through September	=	BLUE
October through December	=	BROWN

A daily visual inspection shall be made of the following to determine any external defects or indication of internal damage prior to use: Cord sets, attachment cap, plug and receptacle of cord sets and any other equipment connected by cord and plug (except for cord sets and receptacles which are fixed and not exposed to damage). Items for inspection are to include:

- i. External defects such as deformed, crushed, missing blades or pins.
- ii. External insulation damage, cuts, separations, burns, runover, etc.

iii. Damaged, cracked - shorted - receptacles/cover-plates, missing items.

Any item inspected that is damaged shall be tagged out of service with a DO NOT USE tag and removed from service until repaired and tested.

Attachment plugs and receptacles may not be connected or altered in a manner which would prevent proper continuity of the equipment grounding conductor at the point where the plugs are attached to receptacles.

Adapters which interrupt the continuity of the equipment grounding connection may not be used.

Employee's hands may not be wet when plugging and unplugging flexible cords and cord and plug connected equipment, if energized equipment is involved.

Portable electric equipment and flexible cords used in highly conductive work locations (wet), or in job locations where employees are likely to contact water or conductive liquids shall be approved for such locations.

A copy of this written program and Documentation of Inspection is kept on file in the Safety Office and at each jobsite (maintained by the Senior Project Safety Coordinator).

Both are available for viewing and copying by any affected employee or regulatory agency conducting an audit, investigation or inspection. (See Attached Documentation Sheet.)

e. Test Instruments, Equipment and Tools

Only qualified persons may perform testing work on electric circuits or equipment. A visual inspection of their test instruments and equipment or tools is required before using. Items to be inspected include:

- i. test leads
- ii. cables
- iii. power cords
- iv. probes
- v. connectors
- vi. insulation on tools

Any defective or damaged item shall be removed from service and no employee may use it until necessary repairs and tests to render this equipment safe have been performed.

All authorized, qualified employees are prohibited from working alone on energized lines or equipment over 600 volts.

f. Use of Personal Protective Equipment

Employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed. It shall be maintained in a safe, reliable condition and periodically inspected or tested. Test date and next test required date must be documented.

These items may include:

- i. Non-conductive head protection.

- ii. Safety glasses with side-shields.
- iii. Face shields.
- iv. Rubber insulating gloves (leather outer covering is allowed)
- v. Rubber aprons.
- vi. Non-conductive work shoes/boots.

g. Alerting Techniques

To control potential employee exposures that could cause injury due to electric shock, burns or failure of electrical parts, appropriate, identified safety signs, symbols or accident prevention tags will be used to warn employees about electrical hazards which may endanger them. Non-conductive barricades may be used in conjunction with signs and tags to limit employee access to exposed work areas, or an attendant may be stationed to warn and protect employees.

h. Insulation and Grounding

Insulation may be damaged by hard usage on the job or simply by aging. If this damage causes the conductors to become exposed, the hazards of shocks, burns and fire can exist. Double insulation may be used as additional protection on the live parts of a tool, but double insulation does not provide protection against defective cords and plugs or heavy moisture conditions.

The use of a ground-fault circuit interrupter (GFCI) is one method used to overcome grounding and insulation deficiencies. This fast-acting circuit breaker senses very small electrical imbalances or current leakage to ground and shuts off the electricity. This equipment will be provided for employees required to perform work using portable electrically operated tools and equipment attached to flexible cord sets when in damp or wet locations or conditions of potential moisture.

i. Electrocution/First Aid

Voltages of less than 600 volts (which are the most common found in this workplace) cause a large majority of electrocutions. The following health effects are possible when exposed to certain currents:

- i. Greater than 3mA = painful shock that can cause indirect accidents.
- ii. Greater than 10mA = muscle contraction, "no-let-go" Danger.
- iii. Greater than 30mA = lung paralysis, usually temporary.
- iv. Greater than 50mA = possible ventricular fibrillation
(heart dysfunction that is usually fatal).
- v. 100mA to 4A = certain ventricular fibrillation, fatal.
- vi. Greater than 4A = heart paralysis, may be temporary; severe burns.

Due to the potential for electrocution, employees who regularly perform work on or around energized electrical equipment will be instructed in CPR/First Aid methods. (Refer to the Medical Services and First Aid Program in this manual).

5. SUMMARY

This program and discussion has been provided to help **H2E** employees in protecting themselves against electrical hazards at all our work locations, using safe work practices, hazard recognition, properly inspected tools and equipment, GFCI's, an assured equipment grounding conductor program, PPE, warning signs or tags, and established authorized personnel to perform electrical work.

Following these rules and regulations will help reduce the number of incidents and injuries from electrical hazards. Work disruptions to perform the necessary daily, quarterly, biannual inspections should require little time compared to the loss that could potentially occur if personnel, equipment or facilities are injured or destroyed.

Non-compliance by any **H2E** employee with any part of this described program will result in disciplinary action as outlined in the Company's Corrective Action and Disciplinary Program found in this manual.