

MCAD

Electrical Safety Program

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MCAD Electrical Safety

Purpose

The Electrical Safety program is designed to prevent electrically related injuries and property damage. This program also provides for proper training of maintenance employees to ensure they have the requisite knowledge and understanding of electrical work practices and procedures. Only employees qualified in this program may conduct adjustment, repair or replacement of electrical components or equipment. Electricity has long been recognized as a serious workplace hazard, exposing employees to such dangers as electric shock, electrocution, fires and explosions. References: NFPA 70E, Electrical Safety Requirements for Employee Workplaces, National Electrical Code (NEC) and OSHA Standard (Electrical Safety) 29 CFR 1910.331 to 1910.339

Responsibilities

Management

- Provide training for qualified and unqualified employees
- Conduct inspections to identify electrical safety deficiencies
- Guard and correct all electrical deficiencies promptly
- Ensure all new electrical installations meet codes and regulations

Employees

- Report electrical deficiencies immediately
- Not work on electrical equipment unless authorized and trained
- Properly inspect all electrical equipment prior to use

Hazard Control

Engineering Controls

- All electrical distribution panels, breakers, disconnects, switches, junction boxes shall be completely enclosed
- Water tight enclosure shall be used where there is possibility of moisture entry either from operations or weather exposure
- Electrical distribution areas will be guarded against accidental damage by locating in specifically designed rooms, use of substantial guard posts and rails and other structural means

- A clear approach and 3 foot clearance in front shall be maintained for all distribution panels. Note: The panel shall not be blocked by equipment or storage per NEC 110.26 (A) (1)
- Electrical conduit shall be fully supported throughout its length. Non-electrical attachments to conduit are prohibited.
- All non-rigid cords shall be provided strain relief where necessary.

Administrative Controls

- Only trained and authorized employees may conduct repairs to electrical equipment.
- Contractors performing electrical work must be hold a license for the rated work
- Areas under new installation or repair will be sufficiently guarded with physical barriers and warning signs to prevent unauthorized entry
- Access to electrical distribution rooms is limited to those employees who have a need to enter
- All electrical control devices shall be properly labeled
- Work on energized circuits is prohibited unless specifically authorized by senior facility management
- All qualified employees will follow established electrical safety procedures and precautions

Protective Equipment

- Qualified employees will wear electrically rated safety shoes/boots.
- Protective clothing for Arc-Flash protection shall be worn – Appendix “A”
- All tools used for electrical work shall be properly insulated
- Electrical rated gloves shall be available for work on electrical equipment

Electrical Equipment

Electrical equipment shall be free from recognized hazards that are likely to cause death or serious physical harm to employees. Safety of equipment shall be determined using the following considerations:

- Suitability for installation and use in conformity with the provisions of this subpart. Suitability of equipment for an identified purpose may be evidenced by listing or labeling for that identified purpose.
- Mechanical strength and durability, including, for parts designed to enclose and protect other equipment, the adequacy of the protection thus provided.

- Electrical insulation.
- Heating effects under conditions of use.
- Arc-flash effects.
- Classification by type, size, voltage, current capacity, and specific use.
- Other factors which contribute to the practical safeguarding of employees using or likely to come in contact with the equipment.

Identification of Disconnecting Means and Circuits

Each disconnecting means for motors and appliances shall be legibly marked to indicate its purpose. Each service, feeder, and branch circuit, at its disconnecting means or overcurrent device, shall be legibly marked to indicate its purpose. These markings shall be of sufficient durability to withstand the environment involved.

A disconnecting means is a switch that is used to disconnect the conductors of a circuit from the source of electric current. Disconnect switches are important because they enable a circuit to be opened, stopping the flow of electricity, and thus can effectively protect workers and equipment.

Each disconnect switch or overcurrent device required for a service, feeder, or branch circuit must be clearly labeled to indicate the circuit's function, and the label or marking should be located at the point where the circuit originates. For example, on a panel that controls several motors or on a motor control center, each disconnect must be clearly marked to indicate the motor to which each circuit is connected. All labels and markings must be durable enough to withstand weather, chemicals, heat, corrosion, or any other environment to which they may be exposed.

Definition of Terms

Qualified Worker: An employee trained and authorized to conduct electrical work.

Unqualified: Employees who have not been trained or authorized by management to conduct electrical work.

Training

Training for Unqualified Employees

Training for Unqualified Employees includes general electrical safety precautions to provide an awareness and understanding of electrical hazards...

Electrical Safety Rules for Unqualified Workers

1. Do not conduct any repairs to electrical equipment

2. Report all electrical deficiencies to your supervisor
- 3 Do not operate equipment if you suspect and electrical problem
4. Water and electricity do not mix.
5. Even low voltages can kill or injure you
6. Do not use cords or plugs if the ground prong is missing
7. Do not overload electrical receptacles

Training for Qualified Employees

Training for Qualified Employees includes specific equipment procedures and requirements of:

Electrical Safety, 29 CFR 1910.331 to 1910.339

Arc-Flash NFPA 70E (see Appendix "A")

Lockout/tagout Procedures

Personal Protective Equipment

Employees working in areas where potential contact with exposed electrical sources is present will be provided and shall use Personal Protective Equipment (PPE). The following rules apply to the use and care of PPEs:

1. PPEs shall be used where contact with exposed electrical sources are present and likely.
2. PPEs shall be designed for the work being performed and environment in which it is used.
3. PPEs shall be visually inspected and/or tested before use. Any defects or damage shall be replaced, repaired or discarded.
4. In cases where the insulating capabilities of the PPEs may be damaged during the work, a protective outer cover, such as leather, must be used.
5. Employees shall wear non-conductive head protection wherever there is a danger of injury from electrical burns or shock from contact with exposed energized parts.
6. Employees shall wear protective eye/face equipment whenever there is a danger from electrical arcs or flashes or from flying objects resulting from an electrical explosion.

Electrical PPE Inspection Schedule

Type of equipment	When to test
Face shields	Verify shield integrity and visibility

Rubber insulating covers	Upon indication that insulating value is suspect.
Rubber insulating blankets	Before first issue and every 12 months
Rubber insulating gloves	Before first issue and every 6 months
Rubber insulating sleeves	Before first issue and every 12 months

Electrical Lockout & Tagout Requirements

Application of locks and tags.

A lock and a tag shall be placed on each disconnecting means used to deenergize circuits and equipment on which work is to be performed, except as provided for below.

1. The lock shall be attached so as to prevent persons from operating the disconnecting means unless they resort to undue force or the use of tools.
2. Each tag shall contain a statement prohibiting unauthorized operation of the disconnecting means and removal of the tag.
3. If a lock cannot be applied a tag may be used without a lock.
4. A tag used without a lock must be supplemented by at least one additional safety measure that provides a level of safety equivalent to that obtained by use of a lock. Examples of additional safety measures include the removal of an isolating circuit element, blocking of a controlling switch, or opening of an extra disconnecting device.
5. A lock may be placed without a tag only under the following conditions:
 - A. Only one circuit or piece of equipment is deenergized, and
 - B. The lockout period does not extend beyond the work shift, and
 - C. Employees exposed to the hazards associated with reenergizing the circuit or equipment are familiar with this procedure.

Working at Elevated Locations

Any person working on electrical equipment on a crane or other elevated location must take necessary precautions to prevent a fall from reaction to electrical shock or other causes. A second person, knowledgeable as a safety watch, must assume

the best possible position to assist the worker in case of an accident. Portable ladders shall have non-conductive side rails if they are used where the employee or the ladder could contact exposed energized parts.

General Protective Equipment and Tools

General Protective Equipment and Tools shall be used when in the proximity of, or working on, exposed energized parts. The following rules apply:

1. When working on or near exposed energized parts, Qualified Employees shall use insulated tools or handling equipment suitable for the voltage present and working environment. In cases where the insulation may be damaged, a protective outer layer should be employed.
2. Fuse handling equipment, insulated for the circuit voltage, shall be used to remove or install fuses when the terminal is energized.
3. Ropes and other hand lines used near exposed energized equipment shall be non-conductive.
4. Follow guidelines posted on electrical equipment for Arc-flash protection.

Warnings and Barricades

Warnings and barricades shall be employed to alert unqualified Employees of the present danger related to exposed energized parts. The following rules apply:

1. Safety signs, warning tags, etc., must be used to warn Unqualified Employees of the electrical hazards present, even temporarily, that may endanger them.
2. Non-conductive barricades shall be used with safety signs to prevent Unqualified Employees access to exposed energized parts or areas.
3. Where barricades and warning signs do not provide adequate protection from electrical hazards, an Attendant shall be stationed to warn and protect Employees.

Portable Equipment Safety Rules

Portable electrical equipment is defined as cord or plug-type electrical devices which includes the use of flexible or extension cords. Examples of portable electrical equipment included powered hand tools, powered bench tools, fans,

radios, etc. The following safety rules apply to portable electrical equipment (PEE):

1. PEE shall be handled in such a manner as to not cause damage. Power cords may not be stapled or otherwise hung in a way that may cause damage to the outer jacket or insulation.
2. PEE shall be visually inspected for damage, wear, cracked or spilt outer jackets or insulation, etc., before use or before each shift. PEE that remain connected once put in place need not be inspected until relocated. Any defects; such as cracked or split outer jackets or insulation must be repaired, replaced or placed out of service.
3. Always check the compatibility of cord sets and receptacles for proper use.
4. Ground type cord sets may only be used with ground type receptacles when used with equipment requiring a ground type conductor.
5. Attachment plugs and receptacle may not be altered or connected in a way that would prevent the proper continuity of the equipment grounding conductor. Adapters may not be used if they interrupt the continuity of the grounding conductor.
6. Only portable electrical equipment that is double insulated or designed for use in areas that are wet or likely to contact conductive liquids may be used.
7. Employees that are wet or have wet hands may not handle PEEs (plug-in, un-plug, etc.). Personal protective equipment must be used when handling PEEs that are wet or covered with a conductive liquid.
8. Locking-type connectors shall be properly locked after connection to a power source.

Electrical Circuit Safety Procedures

Electrical power and lighting circuits are defined as devices specifically designed to connect, disconnect or reverse circuits under a power load condition. When these circuits are employed, the following rules apply:

1. After a protective circuit is disconnected or opened, it may not be connected or closed until it has been determined that the equipment and circuit can be safely energized.
2. Over current protectors of circuits or connected circuits may not be modified
3. Only Qualified Employees may perform electrical tests on energized equipment.
4. Test equipment and all associated test leads, cables, power cords, probes and connectors shall be visually inspected for external damage before use.

Any damage or defects shall be repaired before use tagged and placed out of service.

5. Test equipment shall be rated to meet or exceed the voltage being tested and fit for the environment in which it is being used.

6. Where flammable or ignitable materials are stored electrical equipment capable of igniting them may not be used.

Standard Operating Procedures

Electrical Pre-Work Procedure

Except in extreme cases, work on electrical equipment will be done with all electrical circuits in the work area deenergized by following the Lockout/Tagout procedure. When working on or near energized electrical circuits with less than 30 volts to ground, the equipment need not be de-energized if there will be no increased exposure to electrical burns or to explosion from electric arcs.

To prepare for work on electrical systems or components, the following procedure applies:

Caution: Treat all electrical circuits as "Live" until they have been Tagged and Locked Out and tested by the following procedure.

1. Obtain permission from supervisor to conduct work
2. Lockout and Tagout all sources of electrical power
3. Verify deenergized condition before any circuits or equipment are considered as deenergized.
 - A. A qualified person shall operate the equipment operating controls or otherwise verify that the equipment cannot be restarted.
 - B. Verify proper operation of the Voltmeter at a live electrical source of the same rated voltage as the circuit to be worked.
 - C. Using the Voltmeter, check all exposed circuits phase to phase and phase to ground for evidence of voltage/current in the circuit.
 - D. Conduct work on the circuit only after determining that there is no voltage in any of the exposed circuits.
 - E. If voltage is detected in any exposed circuit, STOP, inform supervisor and determine source and procedure to eliminate voltage.
4. Conduct work
5. Close up all exposed circuits, boxes, controls, equipment.
6. Remove Lockout/Tagout
7. Obtain supervisor permission to energize circuits

Standard Operating Procedure

Working on or Near Exposed Energized Circuits

In the rare situation when energized equipment (or working in near proximity to energized equipment) can not be de-energized, the following work practices must be used to provide protection. Observe Arc-Flash precautions and procedures in Appendix "A".

Caution: Unqualified Employees are prohibited from working on or near exposed energized circuits.

1. Obtain permission from Manager to work on or near energized electrical circuits
2. Lockout and Tagout all circuits possible
3. Treat all circuits as energized.
4. Remove all conductive clothing and jewelry (rings, watches, wrist/neck chains, metal buttons, metal writing instruments, etc.).
5. Use proper personal protective equipment, shields and/or barriers to provide effective electrical insulation from energized circuits. This may include electrically rated insulated gloves, aprons, rubber soled shoes, insulated shields, insulated tools, etc.
6. Provide adequate lighting. Do not enter areas with exposed energized parts unless illumination (lighting) is provided so that Employee may work safely. Do not reach around obstructions of view or lighting (blindly) into areas where exposed energized parts are located.
7. Employees entering a Confined Space with exposed energized parts must use protective barriers, shields, or equipment or insulated materials rated at or above the present voltage to avoid contact.
8. Doors or other hinged panels shall be constructed and secured to prevent them from swinging into an Employee and causing contact with exposed energized parts.
9. Housekeeping in areas of exposed energized parts may not be completed in areas with close contact unless adequate safeguards (insulation equipment or barriers) are present. Conductive cleaning material (Steel Wool, Silicon Carbide, etc.) or liquids may not be used unless procedures (Lock and Tag Out, etc.) are in place and followed.
10. Station a safety observer outside work area. The sole function of this person is to quickly deenergize all sources of power or pull worker free from electrical work area with a non-conductive safety rope if contact is made with an energized electrical circuit.

11. A person qualified in CPR must be readily available to the scene.

Standard Operating Procedure

Re-energizing Electrical Circuits After Work Completed

These requirements shall be met, in the order given, before circuits or equipment are reenergized, even temporarily.

1. A qualified person shall conduct tests and visual inspections, as necessary, to verify that all tools, electrical jumpers, shorts, grounds, and other such devices have been removed, so that the circuits and equipment can be safely energized.
2. Warn employees exposed to the hazards associated with reenergizing the circuit or equipment to stay clear of circuits and equipment.
3. Remove each lock and tag. They shall be removed by the employee who applied it or under his or her direct supervision. However, if this employee is absent from the workplace, then the lock or tag may be removed by a qualified supervisor designated to perform this task provided that:
 - A. The supervisor ensures that the employee who applied the lock or tag is not available at the workplace, and
 - B. The supervisor ensures that the employee is aware that the lock or tag has been removed before he or she resumes work at that workplace.
4. Conduct a visual determination that all employees are clear of the circuits and equipment.

ARC-FLASH

Purpose

The purpose of Arc-Flash procedures are to provide for safe work practices at MCAD to prevent arc-flash injury to employees and contractors who may work on electrically energized equipment. This program will provide for hazard assessment, documentation of electrical hazards, requirements for personal protective equipment, and training.

Definitions

Arc-Flash: When an electric current passes through air between ungrounded conductors or between ungrounded conductors and grounded conductors, the resulting temperature can reach 35,000 degrees F. Exposing the skin to severe burns and ignition of clothing,

Arc-Flash Boundary: The Safe working distance for unprotected persons working on or near exposed energized components.

Default Flash Boundary: In facilities where the voltage is 240 or less, the arc-flash safe working distance extends to four feet from the energized exposed components. Individuals inside this boundary must wear PPE.

Electrically Safe work Condition: A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure absence of voltage, and grounded if necessary. After an *electrically safe work condition* (refer to Lockout/Tagout Program) has been established, electrical hazards no longer exist, and protective clothing is no longer required.

Flash Hazard: A dangerous condition associated with the release of energy caused by an electric arc.

Flash Hazard Analysis: A study investigating a worker's potential exposure to arc-flash energy, conducted for the purpose of injury prevention and the determination of safe work practices and the appropriate level of personal protective equipment (PPE).

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

Hazard Risk Category:

Task Hazard/Risk Category V-rated gloves V-rated Tool

Panels, < 240V

-Circuit breaker or fused switch, covers on	0	N	N
-Work on energized parts, Including voltage testing	1	Y	Y

Panels, Switchboards, 240 – 600V

-Circuit breaker or fused switch, covers on	1	N	N
-Work on energized parts, Including voltage testing	2	Y	Y

Incident Energy: The amount of energy impressed on a surface, a certain distance from the source during an electric arc event.

Personal Protective Equipment and Flame-Resistant Clothing:

Hazard Risk Category Number **0** **1** **2**

Clothing

Non-melting, natural fiber			
-T-shirt			X
-Shirt (long sleeve)	X		
-Pants (long)	X	X	X
Flame-Resistant Clothing			
-Shirt (long sleeve)		X	X
-Pants (long)	X	X (Note 2)	X (Note 4)
-Coverall		Note 3	Note 5
Flame-Resistant Equipment			
-Head protection, (hard hat)		X	X
-Eye protection (glasses)	X	X	X
-Face shield (arc-rated, see Note 6)			X
Hand protection (Note 1)	As needed		X
Foot protection (leather work shoes)	As needed		X

Notes:

X – Required

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

2. Regular weight (minimum 12 oz/yard fabric weight), untreated denim cotton jeans are acceptable in lieu of FR pants

3. Alternate is to use FR coverall (minimum arc rating of 4) in lieu of FR shirt and FR pants

4. If the FR pants have a minimum arc rating of 8, long pants of non-melting or untreated natural fiber are not required beneath the FR pants
5. Alternate is to use FR coveralls (minimum arc rating of 4) over non-melting or natural fiber pants and T-shirt
6. A face shield with a minimum arc rating of 8, with wrap-around guarding to protect not only the face, but also the forehead, ears, and neck (or, alternatively, a flash suit hood), is required

Responsibilities

Safety Coordinator

- Administering this program, ensuring meets the requirements of all applicable codes
- Providing initial and periodic training
- Maintaining training records
- Audit effectiveness of program

Facilities Director

- Ensure all department employees who work on energized equipment are apprised of this program and receive training
- Ensure an Arc-Flash hazard analysis is conducted for the facility
- Ensure department employees follow electrical safe work practices
- Ensure electrical equipment is labeled with the proper risk hazard

Employees

- Wear appropriate FR clothing and equipment
- Follow all safety and department procedures

Program Activities

Arc-Flash Hazard Analysis: NFPA 70E requires that the facility perform a flash hazard analysis prior to allowing a worker to work on energized equipment. The analysis is necessary for determining the flash protecting boundary distance and the type of PPE required. To establish this information, an incident energy calculation is generally necessary.

Electrical Equipment Affected: NEC requires “Switchboards, panel-boards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing or maintenance while energized shall be field marked to warn qualified persons of potential arc-flash hazards”. All designated MCAD equipment meeting the requirements stated above will be labeled with the appropriate Hazard classification.

Hazard Labeling Requirements: Field labeling will be located so as to be clearly visible to persons performing maintenance on energized equipment. This label, is designed to provide warning of potential hazards (is not on older equipment). After the Arc-hazard analysis is completed, the appropriate labeling will be applied to this energized equipment. Future revisions

to the NEC code are expected to require facility owners to place other information on this labeling, including the flash protection boundary, the incident energy level, and the required PPE required to work on the equipment.

Training: Training will be provided initially and periodically to all qualified employees and contractors performing maintenance or installation on energized equipment. Training will provide the necessary information and to enable knowledge to be imparted to workers affected by this program. Prevention of electric arc-flash hazards by understanding the existence, nature, causes, is intended by this training. This training will also include the selection and use of PPE.