# Element 14.1 - Electrical and Machine Safeguarding

## Scope

This program[1] applies to all employees who work with or near equipment that have hazards related to electrical energy or mechanical energy, such as moving parts, cutting edges, nip points, or pinch points.

## Purpose

This program provides employees with the basic information and guidance to help assure that they are not exposed to the risks associated with recognized electrical and machine hazards that may cause serious injury.

## Member-Level Responsibilities

On the line below, list the job title of the person who has primary responsibility for oversight of this policy. _____

The information in this program applies to all employees working on, near, or with electrical systems or equipment and/or machines.

- Managers and first line supervision should evaluate their work areas for compliance with this program, assure the resources are available to meet the needs, and conduct the required inspections of areas for which they are responsible.
- First line supervision should ensure their personnel are familiar with these procedures, adhere to its guidelines, and develop more detailed procedures when necessary.
- Employees have the responsibility to be familiar with and adhere to all aspects of this procedure that apply to their work activities. Any questions regarding the requirements should be directed to their supervisor.

[1] The content of this program is based upon the following regulations:
- Pennsylvania Title 34, Part VIII, Bureau of Workers' Compensation – Chapter 129, Subchapter D §129.452; Group Self-Insurance Fund's AIPP Requirements
- Federal Occupational Safety and Health Administration (OSHA) regulations for Electrical Safety, 29 CFR 1910 Subpart S
- Federal Occupational Safety and Health Administration (OSHA) regulations for Machinery and Machine Guarding, 29 CFR 1910 Subpart O

# Electrical Safety

Electrical safety is achieved through the proper use and installation of electrical equipment. Employees must be properly instructed concerning electrical hazards in their workplaces and understand the necessary safe work practices to avoid injury. Specific electrical hazards in each department shall be identified to employees who have responsibilities to operate equipment in that department. **Due to the potential for serious injury, all electrical hazards and/or incidents should be reported immediately.** All training to meet these requirements must be documented by each employee's supervisor.

This section provides the basic minimum procedures for installing, using, and maintaining electrical equipment properly, and electrical safety related work practices for working on, near, or with energized systems or equipment. Additional detailed information should be obtained from the National Electrical Code (NFPA 70) as needed to ensure proper electrical safety.

## A. Examination, and Installation of Fixed Electrical Systems

All electrical equipment shall be installed and examined to ensure it is free from recognized hazards that are likely to cause death or serious physical harm to employees. **Proper safety shall be determined** by using the following considerations:

- Suitable installation of Underwriters Laboratory listed and labeled equipment, and use per the National Electrical Code, NFPA-70
- Proper mechanical strength and durability, including parts enclosing and protecting equipment
- Protection from heating effects under normal usage
- Arc protection
- Proper classification by type, size, voltage, current capacity, and specific use.
- Any other factors that should be considered to ensure employee safety

## B. Splices in Fixed (Building) Wiring/Systems

Electrical connections must be mechanically joined and secured using appropriate devices (i.e. wire nuts or terminal blocks). Connections will be properly covered/sealed to ensure they are protected from accidental contact or damage from environmental conditions (i.e. electrical tape, heat-shrink, liquid tape, electrical enclosure). All splices and free ends of conductors must be covered with insulation equivalent to that of the conductor or a suitable insulating device.

## C. Arcing Parts

All parts of electrical equipment which, in normal operation, may produce arcs, sparks, flames, or molten metal must be enclosed or separated and isolated from all combustible material.

## D. Marking

Electrical equipment must not be used unless it is marked with the manufacturer's name, trademarks, or other markings identifying the organization responsible for the product. Other markings shall be provided indicating voltage, current, wattage, or other ratings as necessary and shall be of sufficient durability to withstand the given environment.

## E. Identification of Disconnects

Each electrical disconnect switch and breaker must be legibly marked indicating its purpose, unless located so the purpose is evident.

## F. Working Clearances

Indoor areas containing electrical equipment such as disconnects and electrical panels shall be maintained in a clean and orderly fashion, shall not be used for storage, and will have adequate illumination. **Under no circumstances shall any employee place or store any object within 36 inches of the front of an electrical panel.**

## G. Cabinet and Box Openings

All unused openings in electrical junction boxes, electrical enclosures, and breaker panels will be covered or closed to prevent accidental contact and accumulation of dust and debris.
All electrical boxes used for wall switched or electrical outlets will have covers installed on them to prevent accidental contact and accumulation of dust and debris.
All wiring pull boxes and junction boxes will have the appropriate covers installed at all time except when the system is actively being serviced or inspected.

## H. Wiring Methods

1. All permanent building and fixed equipment wiring shall comply with the applicable requirements of the National Electrical Code- NFPA 70.
2. All electrical installations will be performed in a neat and professional manner.
3. A conductor used as a grounded conductor must be permanent, continuous, identifiable and distinguishable from all other conductors.
4. No grounded conductor shall be attached to any terminal or lead that will reverse the designated polarity. Grounding devices must not be used for any other purpose.
5. All non-current-carrying metal parts of portable equipment and fixed equipment, including associated equipment, **must be grounded**.
6. Cords and cables that pass through holes in walls, floors, wood cross members, or partitions must be protected to prevent damage to the outer insulation of the cords or cables by tubes or bushings of noncombustible, nonabsorbent insulated material.
7. All conductors within seven feet from the floor are exposed to physical damage and must be protected.
8. Permanently installed flexible power cords (i.e. lighting fixture cords) must be connected to devices and/or fittings so that strain relief is provided.

## I. Equipment for General Use

1. Damaged equipment and power tools will not be used until they have been serviced and inspected by a competent person. Damaged equipment will be marked or tagged as "OUT OF SERVICE".
2. Fixtures installed in wet or damp locations must be approved for the purpose and be water-tight so water cannot enter or accumulate and come into contact with electrical parts.
3. Areas used for charging lead/acid batteries must have sufficient ventilation to prevent the build-up of flammable or explosive gases.

## J. Temporary Flexible Cords (Extension Cords)

Temporary flexible cords (extension cords) may not be used in place of permanent building wiring. Temporary flexible cords (extension cords) may only be used:

1. During remodeling, maintenance, repair, or demolition of buildings, structures, or equipment, and similar activities
2. For experimental or development work
3. To allow mobility of portable equipment used in multiple locations

Flexible cords and cables must be approved and suitable for the conditions of use and location, and be used at or below the listed voltage and current limits for the cords. Flexible cords and cables can only be used in a continuous single length without splice or tape.

Extension cords cannot be connected to other extension cords.

Temporary flexible cords (extension cords) may not be fastened to equipment or rigid conduit with cable ties or other means; this would be considered as making them permanent building wiring.

If repairs become necessary on equipment power cords or extension cords, the repaired cord must have the same protective rating as the original cord. This means that an "electrical tape repair" is not allowed since it does not provide the same level of protection as the original out jacket insulation. If a power cord's outer jacket is compromised, the tool should be removed from service and the entire cord should be replaced. If the rubber strain relief provided where the cord enters the tool becomes damaged or is missing, the tools should be removed from service until the strain relief can be replaced. If the plug of a cord becomes damaged, either by having the outer jacket insulation pulled out of the plug, or the grounding pin is loose or missing, the tool should be taken out of service until the plug can be replaced. Any repairs to power cords should be done by a competent person that has been trained on how to select the correct replacement parts and how to properly install them.

## K. Work on or Near Live Electrical Systems or Equipment

The preferred and standard method of working on electrical systems and equipment is to use the Lockout/Tagout program in order to minimize risk of damage, injury, and fatalities.
If work on or near live electrical systems or equipment (50 volts or more) must be performed, it will be done in compliance with NFPA 70E by employees who are qualified and trained. If there are no employees currently trained and considered "qualified" under NFPA 70E, the will contract the work to a qualified contractor.

# Machine Safety

Machine hazards are a major cause of accidents and must be identified and controlled to avoid injury to employees working on/or near one of the machines. A hazard is an existing or potential condition that has the potential to harm people, property, or the environment. Thus, any machine motion or condition that can cause injury is considered hazardous and must be guarded. In addition, any guarding supplied by the manufacturer must remain in place on the equipment, except during properly protected repair and maintenance that utilizes energy control procedures, such as Lockout/Tagout. (See the Lockout/Tagout Program). **All guards shall be re-installed before the equipment is returned to service.**

## A. Maintenance, Servicing and Adjustment

All personnel performing servicing and maintenance of machines must be properly trained, qualified, and competent to perform the task.
Only authorized employees are permitted to perform servicing and maintenance on machines in accordance with written Lockout/Tagout Procedures.

## B. Point of Operation

Points of operation are areas of machines where material is processed or changed by the machine, and where work on the material is actually being performed, such as a saw blade cutting a board or drill bit contacting a steel plate.

Point of operation safeguarding depends on the nature of the specific machine and the materials being processed. Normally each machine will be supplied with specific guards specified in ANSI B11.

## C. Mechanical Motion

Rotating, reciprocating and transverse motion all have specific risks associated with working near or on these machines.

1. Rotating Motion: Even slow smooth rotating shafts can pull body parts into dangerous positions. The resulting injuries can be severe or even deadly.
   Such things as collars, couplings, cams, clutched flywheels, shaft ends, spindles and horizontal or vertical shafting are examples of common rotating parts that are dangerous. Those dangers are increased by bolts, nicks, abrasions, projecting keys, or set screws which can serve as a cleat to grab clothing and/or as a protruding cutter head. These projections are difficult to see during rotation and must be made flush with the shaft if possible.

There are three basic in-running nip point hazards that are created by rotating parts.

- If there are parts rotating in opposite directions that are touching or there are rotating parts that are in close proximity, then a hazard exists where workers could be pulled in-between the rotating parts. This type of hazard is commonly found on rolling mills and calendars or machines with intermeshing gears.
- Another nip point is created between rotating and tangential moving parts such as chain and sprocket drives, v-belt drives, or racks and pinions.
- Nip points can also occur between fixed and rotating parts that create a shearing, crushing or abrading hazard. They include: spoked wheels, or flywheels, screen conveyors, or an abrasive wheel and the work rest.

2. Reciprocating Motion: Reciprocating parts create hazards during back and forth or up and down motion that may strike a worker or cause them to be caught between a moving and a stationary part. This could include a bed of a milling machine or a surface grinder.

3. Transverse Motion: Transverse motion or movement in a straight or continuous line creates a hazard when the worker is pulled into the pinch or shear point, or is dragged by the moving parts into other moving parts.

## D. Mechanical Actions

Mechanical actions are machine motions (actions) that include cutting, punching, shearing, bending. Each of these types of action has specific risks associated with working near or on these machines.

1. Cutting Action: A cutting action may be created in any rotating, reciprocating or transverse motion. The hazards of a cutting action are created in many points of operation activities. Injuries may occur to fingers, hands, head, arms, or where flying chips or scrap material may strike the eyes or face. Many examples include the cutting hazards of band saw, circular saw, boring or drilling machines, turning lathes, or milling machines.

2. Punching Actions: A punching action is created when power is applied to a stud or dies for blanking, drawing, or stamping material. A hazard is created at the point where material is inserted, held, or withdrawn by hand. These hazards could be created on power presses, or iron workers.

3. Shearing Action: Shearing action hazards are created when power is applied to a slide or knife to shear or trim materials, such as metal or paper shears.

4. Bending Action: A bending action occurs when two dies are brought together under power to bend, draw, or stamp metal or other material. The hazard is created at the point where hands are used to insert, hold or withdraw material from the point of operation. Equipment creating hazards due to bending action are power presses, press brakes, or tube benders.

## E. Machine Safeguards

One or more methods of machine guarding must be used to protect the operator and others in the machine area from hazards such as:

- Points of operation
- In-going nip points,
- Rotating parts,
- Flying chips and sparks.

1. Safeguard Requirements – All machine safeguards must:

    - Conform to or exceed ANSI requirements,
    - Be considered a permanent part of the machine,
    - Afford maximum protection,
    - Prevent access to danger zone during operation,
    - Not weaken the structure of the machine,
    - Not interfere with machine operation,
    - Be designed for the specific machine and job,
    - Be fire and corrosive resistant,
    - Be durable, and
    - Not be a source of additional hazard.

2. Methods of Machine Guarding

    Virtually all machines have hazardous motions and/or energy that must be effectively guarded to prevent employee injury. **Machines purchased or fabricated must be properly guarded prior to use.** All fabricated or purchased guards shall meet ANSI B11 standards for guards.

## Hazard Inspection Checklist

To assist employees in checking workplaces to assure that recognized hazards are identified and any issues are promptly corrected, hazard inspection checklists are provided on the following pages. Each department is responsible for establishing monthly self-inspections of their work spaces and locations. Each department must ensure the proper follow-up to correct all defects or issues identified. All inspection reports must be filed by the department for future reference.

## Training Requirements

- Only employees who have been specifically trained in the proper methods to install or conduct work on electrical systems or equipment are permitted to perform this work.
- Only employees who have been specifically trained in the Lockout/Tagout program are permitted to work on de-energized electrical systems and equipment.
- Only employees who have received specific training as a “Qualified employee” as per NFPA 70E are permitted to work on any energized system or equipment over 50 volts.
- Documentation of employee training will be maintained by the supervisor of each department.

| General Electrical Safety MONTHLY Inspection Checklist | Yes | No | NA |
|---|---|---|---|
| 1. Electrical equipment and systems are free of recognized hazards or visible damage. | | | |
| 2. Electrical Boxes and Disconnects are not blocked by materials, are easily accessible, and have at least 36" of clearance in front of them. | | | |
| 3. Electrical Disconnects and circuits are labeled with the equipment or system that they control. | | | |
| 4. All electrical boxes, outlets, and wall switch boxes have proper covers installed. | | | |
| 5. Power cords and extension cords are not run through doors or windows. | | | |
| 6. Electrical equipment used in wet locations or outdoors is rated and suited for use in those conditions. | | | |
| 7. All electrical wires/conductors terminate in an approved electrical box (no exposed wires with wire nuts, etc.) | | | |
| **Comments**: | | | |

| Power & Extension Cord MONTHLY Inspection Checklist | Yes | No | NA |
|---|---|---|---|
| 1. Power cords and extension cords being used are the proper type and size for the task. Specific cords approved for wet locations are used when necessary. | | | |
| 2. All extension cords are grounded cords, and grounding pin intact. | | | |
| 3. All power cords and extension cords are in good repair, without damage to the outer jacket insulation, plugs, or pins. | | | |
| 4. Inline or built-in GFCI devices are used when cords are used in wet locations or during construction activities. | | | |
| 5. Extension cords are used for temporary purposes only, and not as a replacement for permanent building wiring. Extension cords are not zip-tied or otherwise connected to existing conduit or other building features. | | | |
| 6. Cords and cables that pass through holes in walls, floors, wood cross members, or partitions are protected by tubes or bushings of noncombustible, nonabsorbent insulated material to prevent damage to the outer insulation of the cord or cable. | | | |
| 7. Power cords and extension cords are run so that they do not create tripping hazards. | | | |
| 8. Equipment with damaged cords have been removed from service. | | | |
| 9. Repairs to power cords or extension cords have been made by a qualified person, and the repairs have the same or greater protective qualities as the original cord or plug. | | | |
| **Comments**: | | | |

| Electrical Boxes and Disconnects MONTHLY Inspection Checklist | YES | NO | NA |
|---|---|---|---|
| 1. All electrical enclosures are appropriate for the environment that they are exposed to. | | | |
| 2. Electrical boxes, breaker panels, and electrical disconnects are in good repair and without obvious physical damage. | | | |
| 3. All unused openings in the top, sides, and bottom of electrical boxes, breaker panels, electrical disconnects, pull boxes, and junction boxes are closed or sealed. | | | |
| 4. All breaker spaces in breaker boxes that are not being used are effectively covered. | | | |
| 5. All pull boxes and junction boxes have their covers securely in place. | | | |
| 6. All circuit breakers and electrical disconnects are labeled with the equipment or branch circuit that they control. | | | |
| 7. All rigid conduit is in good repair and securely attached to the building structure and to the boxes that they enter. | | | |
| 8. All wires either end or are connected inside of a closed electrical box. | | | |
| 9. There is clear and easy access to all breaker panels and electrical disconnects, and there are proper clearances around these fixtures. | | | |
| 10. All breaker panels and electrical disconnects are well lit. | | | |
| 11. Fuses in three-phase fused disconnects are all replaced at the same time with appropriately sized fuses. | | | |
| **Comments:** | | | |

| General Machine Guarding MONTHLY Inspection Checklist | YES | NO | NA |
|---|---|---|---|
| 1. All machine guards prevent workers' hands, arms, and other body parts from making contact with dangerous moving parts. | | | |
| 2. All guards are firmly secured and not easily removable. The provided guards are installed correctly, completely (no missing screws or bolts), and are secure. | | | |
| 3. Machines with point-of-operation hazards are provided with guarding for those points-of-operation. Fingers, hands, toes, etc. cannot reach through the gaps in the guard such that they can contact the points-of-operation. | | | |
| 4. All gears, sprockets, pulleys, drive belts, and flywheels are guarded to prevent access to the in-running nip points. | | | |
| 5. All set-screws on rotating shafts are either flush with the collars, or are guarded against contact. | | | |
| 6. Start/Stop switches and/or emergency stop switches are within easy reach of the operator of the equipment. | | | |
| **Comments:** | | | |

| Equipment-Specific Machine Guarding MONTHLY Inspection Checklist | YES | NO | NA |
|---|---|---|---|
| 1. Table Saws - All table saws have the blade guard, splitter, and anti-kick back pawls securely installed. | | | |
| 2. Table Saws- All drive belts and drive pulleys are covered by properly covering guards. | | | |
| 3. Bench-top & Pedestal Grinders - The work rests on all grinders are adjusted to within 1/8” of the grinding wheel. | | | |
| 4. Bench-top & Pedestal Grinders - The tongue guards on all grinders are adjusted to within ¼” of the grinding wheel. | | | |
| 5. Bench-top & Pedestal Grinders - The grinding wheel is properly dressed and square. | | | |
| 6. Angle Grinders - All angle grinders have OEM cup/disk guards installed. | | | |
| 7. Air Compressors - The drive belts and pulleys on air compressors are fully enclosed by a solid guard, or by expanded mesh with openings less than 1/2”. | | | |
| 8. Pump Shafts and Collars - All rotating pump shafts, shaft collars, and rotating motor cooling fins are guarded against contact. | | | |
| **Comments:** | | | |