



ENERGY STAR
LIGHTING ELECTRIC INC.

Safety Manual



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Emergency Procedures

Jobsite emergency procedure:

*It is often hard to determine right away **what** and **how** something happened. Therefore, the immediate concern is to care for the injured person, and control access to site, to avoid harmful exposure and enable accurate investigation in the future. Proper communication is vital to proper handling of the situation.*

1. An emergency occurs.

An employee falls from a dangerous height and is injured.

2. Immediate actions are taken.

Several actions must occur simultaneously under the direction of the foreman. It is vital to remain calm and think through the actions.

- a. Stay with the person having a medical emergency. Avoid contact with the persons bodily fluids.
- b. Instruct another employee to inform all other employees on site to stop work and meet in a designated area.
- c. Administer first aid to the injured person if trained to do so. First aid kits are in every company vehicle.
- d. Account for all other jobsite personnel at the designated area.

3. Immediately inform:

- a. Local Paramedics (if person is immobile, or the injury is serious enough) _____ 911
- b. Safety Manager _____ (401)307-3753
- c. Senior Project Manager _____ (916)239-5861
- d. Director of Operations _____ (916)212-3491
- e. Insurance Carrier _____ (916)717-4927

4. If a person has a minor injury (*for example: a sprained ankle*) – drive the injured person to a nearby hospital.

Hospital locations will be provided per project and will also be included on project specific safety documents.

5. The area involved will be sealed off, so that nothing is added or removed from the location of the accident. In cases of serious accidents, the PM, Senior PM, Director of Operations and/or the Safety Manager will report to site to investigate.

6. All witnesses to the accident will be identified and their names, address, and phone numbers noted.



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Emergency Procedures (continued)

7. The job will be shut down and workers will leave the premises.
8. Information is not to be given to anyone over the phone. Any person requesting information will be asked for name and phone number. Replies will be made as conditions permit.
9. The Project Manager and the Director of Operations will prepare a memo available for internal staff distribution as situation permits.
10. Client questions should be directed to the President.
11. Foreman/PM or a designated investigator must file form 301, available at:
<http://safety.esleinc.com/employee-services/osha-301-incident-report/>

First Aid

First Aid Requirements

1. A first aid and CPR certified individual must be present onsite wherefore electrical work is performed.
2. The first aid kits meeting ANSI Z308.1 must be present on all worksites and must be adequate for the size of the group.
3. Employees who administer first aid must use proper personal protective equipment such as latex gloves, eye protection, CPR ventilation devices to avoid blood and or body fluids. Employees must comply with OSHA Blood Borne Pathogen standard set forth in 29 CFR §1910.1030



Purpose:

Research shows that drug and alcohol use is directly related to the number of jobsite accidents and injuries. An employee under the influence of drugs and alcohol is a safety threat to oneself, other employees, and company property. Therefore, ELSE is determined to provide a drug and alcohol-free work environment.

All use of marijuana, illegal drugs, inhalants, and alcohol is prohibited while working, or while on company property. Employees can work while using prescription medications **only if it is prescribed in their name**, and in the opinion of prescribing physician that it will not decrease the employee's fitness to work safely.

Scope:

This policy applies to all current employees, perspective employees, and all subcontractors. The Human Resource Manager is responsible for administrating the policy.

Policy:

Employee Assistance

1. Substance abuse is extremely harmful to oneself and is a safety threat to others. If you have an alcohol or drug problem, contact the HR Manager, and seek help before becomes a disciplinary issue.
2. Employee can use accrued paid time off, be placed on leave of absence, or be accommodated otherwise for a drug treatment program.
3. An active employee in a drug treatment program must document that he or she follows the prescribed treatment. The employee may be subject to additional drug test if the employee holds safety sensitive job or has violated the drug policy in the past. *Examples of safety sensitive jobs include but are not limited to electrical work and driving.*
4. Once a drug test has been scheduled, an employee forfeits the opportunity for a leave of absence unless otherwise required by FMLA and ADA regulations. An employee may face further discipline, up to and including termination.



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Drug Policy – Work Rules

Work Rules:

1. Using, possessing, buying, selling, manufacturing or dispensing illegal drugs, marijuana and alcohol is prohibited while working, operating a company vehicle, while present on company premises or conducting company – related work offsite.
2. Employees are to have no detectable amount of marijuana, alcohol or any illegal drug in their body while performing company business or while present on company property.
3. Employees are not to perform work if the use of a prescribed medication creates a work safety threat to themselves or others. The employee must consult with the doctor about the medication effect on ability to work safely. Any safety complications due to medication use must be disclosed to the Safety Manager. Failure to disclose constitutes a violation of this policy.
 - a. No prescription medication is to be used by the employee unless it is prescribed by a licensed physician.
 - b. Employees who use prescription medication must carry the medication in original bottle written to their name by a licensed pharmacist.
 - c. Use of legal but illicitly used substances that may pose a safety hazard is prohibited.
4. Company may remove any person from any company property or work site who is in violation this policy. Under no circumstances will the employee or sub-contractor be allowed to remain on the work site while under influence. The employee constitutes a serious danger to oneself and others.
5. Illegal drugs or drug paraphernalia of the employee will be turned over to law enforcement. This may result in criminal prosecution...
- 6. Entry on company property, jobsite or company paid hotel room is a consent to and recognition of the authority of the company or its representatives to search the person, vehicle, and other property of individual while entering, on, or departing from company property, jobsite, or company paid hotel room.**



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Fleet Policy

Purpose:

The purpose of this policy is to ensure the safety of those individuals who drive company vehicles and to provide guidance on the proper use of ESLE fleet vehicles. Vehicle accidents are costly to our company, but more importantly, they may result in injury to you or others. It is the driver's responsibility to operate the vehicle in a safe manner and to drive defensively to prevent injuries and property damage. The employer expects each driver to drive in a safe and courteous manner pursuant to the following safety rules. The attitude you take when behind the wheel is the single most important factor in driving safely.

Guidelines:

1. Company vehicles are to be driven by authorized employees only, except in case of repair testing by a mechanic.
2. Any employee who has a driver's license revoked or suspended shall immediately notify the fleet office by 9 a.m. Pacific time the next business day, and **immediately discontinue operation of the company vehicle**. Failure to do so may result in disciplinary action, including termination of employment.
3. All accidents in company vehicles, regardless of severity, must be reported to Fleet office. Accidents are to be reported immediately (from the scene, during the same day, or as soon as practicable if immediate or same day reporting is not possible). Accidents in personal vehicles while on company business* **must** follow these same accident procedures. Failing to stop after an accident and/or failure to report an accident may result in disciplinary action, up to and including termination of employment.
4. Drivers must report all ticket violations received during the operation of a company vehicle, or while driving a personal vehicle on company business, within 24 hours to the Fleet office.
5. Motor Vehicle Records may be obtained on all drivers prior to employment. A driving record that fails to meet the criteria stated in this policy or is considered to be in violation of the intent of this policy and will result in a loss of the privilege of driving a company vehicle.

Driver Criteria:

Employees must have a valid and current Driver's license to operate a company vehicle, or a personal vehicle with current auto insurance while on company business.

Employees are expected to drive in a safe and responsible manner and to maintain a good driving record.



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Fleet Policy – Safety Rules

Safety Rules:

1. Driving on company business and/or driving a company vehicle while under the influence of intoxicants and other drugs (which could impair driving ability) is forbidden, and is sufficient cause for discipline, up to and including termination of employment. While cellular communication during driving is permitted in various states, it is ESLE policy that cellular business-related communication while driving is strictly prohibited unless using a hands-free device. It is also policy that at no time may an employee send or read business-related electronic communications such as text messages, instant messages and/or e-mails while driving (please note that even voice texting should be done when the vehicle is stopped).
2. Energy Star Lighting Electric believes that while driving a vehicle that the driver's full attention should be on the road, their surroundings and safely operating the vehicle. Other activities are a distraction from their primary task and should be reserved for when they are not operating the vehicle. All fines and citations received during the course of business may be the responsibility of the employee if the fines and/or citations are due to employee negligent. All non-work-related cell phone use shall be reserved for break and meal times.
3. No driver shall operate a company vehicle when his/her ability to do so safely has been impaired by illness, fatigue, injury, or prescription medication.
4. All drivers and passengers operating or riding in a company vehicle must wear seat belts, even if air bags are available.
5. No unauthorized personnel can ride in company vehicles.
6. Drivers are responsible for the security of company vehicles assigned to them. The vehicle engine must be shut off, ignition keys removed, and vehicle doors locked whenever the vehicle is left unattended.
7. Head lights shall be used 2 hours before sunset and until 2 hours after sunrise, or during inclement weather or at any time when a distance of 500 feet ahead of the vehicle cannot be clearly seen.
8. All State and Local laws must be obeyed.



Defensive Driving Guidelines:

- Drivers are required to maintain a safe following distance at all times. Drivers should keep a two second interval between their vehicle and the vehicle immediately ahead. During slippery road conditions, the following distance should be increased to at least four seconds.
- Drivers must yield the right of way at all traffic control signals and signs requiring them to do so. Drivers should also be prepared to yield for safety's sake at any time. Pedestrians and bicycles in the roadway always have the right of way.
- Drivers must honor posted speed limits. In adverse driving conditions, reduce speed to a safe operating speed that is consistent with the conditions of the road, weather, lighting, and volume of traffic. Tires can hydroplane on wet pavement at speeds as low as 40 mph.
- Radar Detectors are strictly prohibited in company Vehicles. Drivers are to drive at the speed of traffic but never to exceed the posted speed limit.
- Turn signals must be used to show where you are heading; while going into traffic and before every turn or lane change.
- When passing or changing lanes, view the entire vehicle in your rear-view mirror before pulling back into that lane.
- Be alert of other vehicles, pedestrians, and bicyclists when approaching intersections. Never speed through an intersection on a caution light. When the traffic light turns green, look both ways for oncoming traffic before proceeding.
- When waiting to make left turns, keep your wheels facing straight ahead. If rear ended, you will not be pushed into the lane of oncoming traffic.
- When stopping behind another vehicle, leave enough space so you can see the rear wheels of the car in front. This allows room to go around the vehicle if necessary, and may prevent you from being pushed into the car in front of you if you are rear-ended.

Large vehicle/trailer backing:

- According to the National Safety Council, one out of four vehicle accidents can be blamed on poor backing techniques. Avoid backing where possible, use a spotter.
- **A driver should use another person to help them when backing. The driver and spotter should use hand signals instead of verbal ones and make sure they understand each other. The spotter will stand on the hazard side if possible when backing. The spotter will not walk backwards while backing.**



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Fleet Policy – Accident Procedures

Accident Procedures:

1. In an attempt to minimize the results of an accident, the driver must prevent further damages or injuries and obtain all pertinent information and report it accurately.
 - Call for medical aid if necessary.
 - Call the police. All accidents, regardless of severity, must be reported to the police. If the driver cannot get to a phone, he should write a note giving location to a reliable appearing motorist and ask him to notify the police.
 2. Record names and addresses of driver, witnesses, and occupants of the other vehicles and any medical personnel who may arrive at the scene.
 - Do not accept any responsibility for the accident. Don't argue with anyone.
 3. Provide the other party with your name, address, driver's license number, and insurance information.
 4. Immediately report the accident to the Fleet office. Provide a copy of the accident report and/or your written description of the accident to the Fleet office ASAP.
-
- There will be a formal accident review conducted on each accident to determine cause and how the accident could have been prevented.
 - **Driver must maintain and follow all posted and implied laws and ordinances.**



Accident/Incident Reporting

This document contains reporting requirements only. Other emergency actions may need to take place independently of the steps outlined in this document.

Work Accidents:

1. Must be reported to your supervisor as soon as possible.
2. Must be reported to Safety Manager as soon as possible.
3. If a serious injury has occurred, must report to Safety Manager and Director of Operations, as well as Senior PM immediately.
4. Foreman, Supervisor onsite, or an assigned investigator must fill out form 301 (online) as soon as possible. <http://safety.esleinc.com/employee-services/osha-301-incident-report/>

Near-Misses:

1. Must be reported to Safety Manager and Senior PM.
2. Must be discussed at the following Toolbox Meeting.
3. Must be documented on the same day (online) <http://safety.esleinc.com/report/>

Safety Violations:

It is everyone's duty to themselves and their coworkers to report any and all safety violations as soon as possible. By doing so, you will save lives, and one of those lives can be your own.

1. Must be reported to Safety Manager and Senior PM.
2. Must be discussed at the following Toolbox Meeting.
3. Must be documented on the same day (online) <http://safety.esleinc.com/report/>

Auto Accidents:

1. Must be reported to police immediately. Dial 911.
2. Must be reported to Fleet Manager.
3. Must be reported to Safety Manager.
4. Must be reported to Insurance Carrier.

Harassment Reporting:

1. Bystander report: must report observed harassment to HR Manager, (or another manager that you're comfortable reporting to)
2. Victim report: report to HR manager or any other manager that you're comfortable reporting to.
3. Report form available on the website: <http://employee-services.esleinc.com/harassment-report/>
4. Anonymous report: fill out an online form at: <http://safety.esleinc.com/anonymous-issue-report/>

Hazard Communication (HazCom)


Purpose:

The purpose of this training is to learn to recognize, read and understand product labeling, to insure the employee safety from hazardous substances.

Standard label contains:

1. Product identifier.
 - Chemical name, code number, or batch number.
2. Signal word.
 - “Danger” or “Warning”.
3. Hazard statement(s).
 - Description of the nature of the hazard(s) of the chemical, including where appropriate, the degree of hazard.
4. Pictogram(s).
 - Black hazard symbol with red frame.
5. Precautionary statement(s).
 - A phrase that describes recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure.
6. Name, address and phone number of the manufacturer/importer/responsible party.

Sample label:

SAMPLE LABEL		
<p>CODE _____</p> <p>Product Name _____</p>	<p style="color: blue;">Product Identifier</p>	<p style="color: blue; text-align: center;">Hazard Pictograms</p> <div style="text-align: center;">  </div> <p style="color: blue; text-align: center;">Signal Word Danger</p>
<p>Company Name _____</p> <p>Street Address _____</p> <p>City _____ State _____</p> <p>Postal Code _____ Country _____</p> <p>Emergency Phone Number _____</p>	<p style="color: blue;">Supplier Identification</p>	<p style="color: blue;">Hazard Statements</p> <p style="text-align: center;">Highly flammable liquid and vapor. May cause liver and kidney damage.</p>
<p>Keep container tightly closed. Store in a cool, well-ventilated place that is locked. Keep away from heat/sparks/open flame. No smoking. Only use non-sparking tools. Use explosion-proof electrical equipment. Take precautionary measures against static discharge. Ground and bond container and receiving equipment. Do not breathe vapors. Wear protective gloves. Do not eat, drink or smoke when using this product. Wash hands thoroughly after handling. Dispose of in accordance with local, regional, national, international regulations as specified.</p> <p>In Case of Fire: use dry chemical (BC) or Carbon Dioxide (CO₂) fire extinguisher to extinguish.</p> <p>First Aid If exposed call Poison Center. If on skin (or hair): Take off immediately any contaminated clothing. Rinse skin with water.</p>	<p style="color: blue;">Precautionary Statements</p>	<p style="color: blue;">Supplemental Information</p> <p>Directions for Use</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Fill weight: _____ Lot Number: _____ Gross weight: _____ Fill Date: _____ Expiration Date: _____</p>



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Hazard Communication - Pictograms



Health Hazard

Carcinogen, Reproductive Toxicity, Respiratory Sensitizer, Target Organ Toxicity, Aspiration Toxicity, Mutagenicity.



Flame

Self-Reactives, Emits Flammable Gas, Pyrophorics, Self-Heating, Organic Peroxides.



Exclamation Mark

Irritant (skin & eye), Skin Sensitizer, Acute Toxicity, Narcotic Effects, Respiratory Tract Irritant.



Gas Cylinder

Gasses under pressure.



Corrosion

Skin Corrosion / Burns, Eye Damage, Corrosive to Metals.



Exploding Bomb

Explosives, Self-Reactives, Organic Peroxides.



Flame over Circle

Oxidizers.



Skull and Crossbones

Acute Toxicity (fatal or toxic).



SDS is a new standard that have replaced MSDS. SDS documents are comprised of 16 sections, and these sections appear in a specific order that is the same across all products.

Section 1: Identification - If you want to know the name of the product or its common chemical name, this is the section where you will look. It also identifies the manufacturer, their address and emergency contact information, and recommendations or restrictions for the product's use.

Section 2: Hazard(s) identification – This section lists the hazard classifications, signal word, hazard statements, precautionary statements, and pictograms that appear on the container label will also appear in this section of the SDS.

Section 3: Composition/information on ingredients – Here you'll find the name of each hazardous chemical present in the product (including percentages for each chemical if the product is a mixture). You will also find the identity of any impurities and stabilizing additives which are hazardous and contribute to the classification of the chemical, along with any unique identifiers such as the Chemical Abstracts Service (CAS) number.

Section 4: First-aid measures – Here is where you will find a description of the initial care that should be given by untrained responders to an individual who has been exposed to the chemical, including necessary first-aid instructions by relevant routes of exposure (inhalation, skin and eye contact, and ingestion). There will also be information about the most important symptoms or effects that are acute or delayed, along with recommendations for immediate medical care and special treatment needed, when applicable.

Section 5: Fire-fighting measures – Here you will find recommendations of suitable equipment for extinguishing a fire involving the chemical, as well as information about extinguishing equipment that is not appropriate. There are also warnings about any hazardous by-products created when the chemical burns.

Section 6: Accidental release measures – This section provides recommendations on appropriate response to spills, leaks, or accidental releases of the chemical, including containment and cleanup practices to prevent or minimize exposure to employees and the general environment.

Section 7: Handling and storage – Provides guidance on the safe handling practices and conditions necessary for the safe storage of the chemical. This includes precautions for safe handling, including recommendations for handling incompatible chemicals, minimizing the release of the chemical into the environment, and recommended general hygiene practices (e.g., eating, drinking, and smoking in work area), as well as identification of any incompatibles.

Section 8: Exposure controls/personal protection – This section provides the OSHA permissible exposure limits for the chemical(s), suitable engineering controls (such as ventilation systems), and recommended personal protective equipment (PPE) for workers to help prevent exposure.

Section 9: Physical and chemical properties – Technical information about the product, such as its flash point (temperature it gives off enough vapors to ignite and burn), vapor density (tells if vapors are lighter or heavier than air), and a whole lot more is provided in this section.

Section 10: Stability and reactivity – This section discusses whether the chemical is stable or unstable under normal ambient temperature and conditions while in storage or while being handled. And information about possible hazardous reactions, conditions to be avoided, and incompatible products and agents appears in this section too.

Section 11: Toxicological information – Here you can see the toxicological and health effects, if any, of over-exposure to the chemical, as well as information about known or likely routes of exposure (inhalation, ingestion, skin and eye contact) and a description of symptoms of over-exposure.



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Hazard Communication – SDS (Unregulated Sections)

Section 12: Ecological information – This section will contain information of hazard to environment.

Section 13: Disposal considerations – Here you'll find information on how to properly dispose of the product.

Section 14: Transport information – This section discusses transportation requirements.

Section 15: Regulatory information – In this section you'll find other regulatory information that is not controlled by OSHA.

Section 16: Other information – Contains the date of preparation or of last revision for the SDS.

Hazard Communication – Policies

Reporting Requirements:

All employees are required to report newly identified hazards to their immediate supervisor and are encouraged to contact the Safety Manager directly as well.

1. Workers must be trained on the hazards associated with any chemical related to the project.
2. A chemical inventory list and the Safety Data Sheet (SDS) must be maintained for any chemicals used in the project work.
3. All hazardous materials should be stored in clearly marked, appropriate containers.
4. All hazardous materials must be labeled with name of the material, the hazards associated with it, and the necessary precautions to be followed.
5. All employees must avoid unnecessary contact with hazardous material. If coming in contact use appropriate PPE, such as gloves, goggles, aprons, and respirator.

Access to Safety Data Sheets

All employees can access the Safety Data Sheets at the request to their Foremen. If a physical copy is not immediately available an electronic copy can be obtained by calling the Safety Manager at (401)307-3753.

The person (Proposals, PM, etc.) specifying a chemical for use at a project must provide a copy of the SDS to the Safety Manager, failure to do so will result in a write-up.



Understanding Electricity - Basics

➤ IN THE CONTEXT OF COMMERCIAL ELECTRICAL WORK.

Q What is electricity?

A *Electricity is a force generated by the movement of electrons between atoms caused by unequal electrical potential of conductive objects.*

Unequal potential can be caused by:

- Chemical reactions (Batteries, Fuel Cells)
- Interactions of moving magnetic fields (Alternators, Transformers¹)
- Shifting energy levels in atoms (Solar cells, TEGs)
- Change in atomic structure (Piezo devices)
- Movement or friction (Static electricity, Lightning)

Electricity needs something to flow through for the potentials to be equalized.

- **Insulators** - plastics, dry wood, room temperature glass, fiberglass, rubber, silicone – do not allow electricity to flow through them.
- **Poor conductors** – water, green/wet wood or other plants, hot glass, living organisms, dirt, various metalized paints – conduct electricity, but with a relatively high resistance, generating heat and damage in process.
- **Resistors** – specialized electrical/electronic parts – resist the flow of electricity at a predetermined rate. These devices are used to control the amount of current that runs through various components in the circuits.
- **Semiconductors** – diodes, transistors – electronic components that conduct electricity under some conditions but not under other conditions.
- **Conductors** – usually metals – conduct electricity very well. Copper, Aluminum, Silver and Gold are commonly used for wiring. While these metals have a very low resistance, it does need to be accounted for to properly size wires and prevent the system from overheating.
- **Superconductors** – specialized compounds that have no electrical resistance. These compounds require a very low temperature.

¹Transformers do not generate power, however, the same exact force is used to transmit power within a transformer as used to generate power within an alternator.



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Understanding Electricity – Circuits

➤ IN THE CONTEXT OF COMMERCIAL ELECTRICAL WORK.

Q What is a circuit?

A *A circuit is a complete loop of wiring and devices, that connects to both sides of a device that generates a potential difference. When a circuit is complete, it is possible to extract useable work from the force that is caused by the flow of electrons equalizing the potential difference.*

Flow of electricity through a circuit allows us to extract energy to produce useable work, such as lighting a bulb or turning a motor.

- Circuit must be complete for electricity to flow. A switch, for example, works by breaking and reconnecting a circuit.
- Conductors must have adequate capacity for the required current.
- When current comes from different potentials, a return path may be shared, as long as the combined current is within the rating of the conductor. In AC systems (where current reverses flow many times each second), a return path may be shared between adjacent phases, as long as the same phase is not used more than once.
- When working with multiple circuits and installing multiple fixtures that use only one circuit each – the fixtures should be evenly distributed among the available circuits to keep the load balanced.



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Understanding Electricity – Supply Systems

➤ IN THE CONTEXT OF COMMERCIAL ELECTRICAL WORK.

You will be working on the following voltage supply systems that are common in North America:

- 120/240 – Two phase residential (actually, single phase 240 with center neutral).
- 120/208 – Three phase Star system with common neutral, most commonly light commercial.
- 120/240 Delta (Stinger leg) – Three phase Delta system, with one center neutral between phases A & C (used to be more common, usually found in mixed commercial/residential areas).
- 277/480 – Three phase Star system with common neutral, most commonly used in heavy commercial.
- 480 – Three phase Delta system without neutral, industrial.
- High Voltage supply systems (you will not be working on these).

Electrical technician must pay attention to labels and taps on existing devices being removed, to make sure that the voltage supply is compatible with the requirements of the device being installed. If no labels or taps are visible, the technician must be able to and know how to measure voltage of the system, and make sure that the voltage measured falls within the specification.



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Understanding Electricity – Calculating Load

➤ IN THE CONTEXT OF COMMERCIAL ELECTRICAL WORK.

AMPS & WATTS

$E = I * R$ (or $V = I * R$)

- Remember this like your life depends on it! Because it DOES!
- E lectromotive force is Volts, I ntensity is Amps, R esistance is Ohms

Where does “Watts” come it?

$P = E * I$ (or $P = V * I$)

- P ower is Watts, E lectromotive force is Volts, I ntensity is Amps

Any load on your circuit can be easily calculated using these two SIMPLE formulas.

CALCULATING LOAD

How many fixtures can I put on this circuit? (what you need to know)

- What is the supply voltage?
- How many Watts does the fixture draw?
- What is the available circuit capacity? (Amps)

For example, a single 15A circuit at 120V is capable of supporting over 40 of the 41W led luminaires, while a single 20A circuit at 277V is capable of supporting over 130! Let's see how we know this:

$P = E * I$, for example 1, $I = 15$, $E = 120$, so the available P is $15 * 120 = 1,800$ Watts, $1800 / 41 = 43$ fixtures.

In example 2, $I = 20$, $E = 277$, so the available P is $20 * 277 = 5,540$ Watts, $5540 / 41 = 135$ fixtures.

That said, a circuit should never be loaded to its full capacity for several reasons, including code regulations, but mainly because the fixtures draw significantly more current when they're initially turned on than during normal operation.



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Understanding Electricity – Grounding & Water Ingress

- IN THE CONTEXT OF COMMERCIAL ELECTRICAL WORK.

GROUNDING

Q Why do we need to ground things?

- A To ensure that all the voltage levels stay within the expected range in relation to conductive objects.
- A To provide a safe path for the fault current to flow.
- A To dissipate Voltage transients (Static, magnetic fluctuations, lightning strikes, faulty equipment).

“Voltage” does not “run to ground”, it runs back to the source! It is necessary to ground electrical systems to protect from transients, and to have all the voltages at expected levels, resulting in ground being an available path back to source.

WATER

Water can conduct electricity, corrode and damage the internal components of the fixtures.

When installing fixtures in a wet location or outside:

- Think of the way the water flows
- Always seal the top of the fixture
- Always allow an exit path for water at the lowest point of the fixture

Identify sources of water ingress:

- Water dripping directly on to the fixture
- Water flowing along the surface of the wall
- Water that may have entered the conduit elsewhere. Is the conduit coming into the fixture from above? Is the conduit coming from above right before entering the back of the fixture? Does the conduit show signs of water presence like corrosion or mineral residue?
- Are all the penetrations properly sealed? Screws Siliconed? Plugs are tight?



Lock-Out – Tag-Out (LOTO)

Why do we need to lockout/tagout?

Some facts about your body:

- Your body uses electricity to function. Electricity is used to control heartbeat, breathe, move muscles, think, etc.
- Your body operates at a much lower voltage and current than you'll be working with.
- You will lose control of your body and will not be able to think properly while experiencing an electric shock.

How much current does it take to kill you?

- You can feel an electric shock and be in danger under certain conditions at only 1/1000th on an Amp.
- At 1/200th you start having involuntary muscle contractions, and while an average individual is not yet in danger, some individuals may sustain injury or be unable to “let go”.
- At 1/100th of an Amp majority of individuals are unable to let go due to the muscle contractions and experience a painful shock.
- At 1/50th of an Amp you will be unable to move or breathe.
- At 1/10th of an Amp your heart will stop, and you will die.

Who needs to be trained on lockout/tagout?

- Affected employee – any employee who might come in contact with electricity if the circuit that is being worked on is re-energized, or any employee working in the affected area where the work is performed.
- Authorized employee – an employee personally responsible for de-energizing the circuit, attaching and removing the tag, and re-energizing the circuit.
- Other employee – any other employee not in direct contact with the circuit or equipment being worked on, but who is working in the same area and may have access to either the equipment/circuit or the lockout/tagout device.

What is an energy isolating device?

- A mechanical device that physically prevents the transmission of electricity.
- A circuit breaker.
- A disconnect switch.
- A manual switch that cannot be remotely controlled.
- A plug, if under exclusive control of the person working on the equipment.
- NOT a push button.
- NOT a selector switch.
- NOT a control circuit.



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What is a lockout device?

- A device that uses a positive means such as a lock (either key or combination), to hold an energy isolating device in the safe position and prevent the re-energizing of the circuit/equipment being worked on.
- Able to withstand the environment in which it is used.
- Must not be easily or inadvertently removed without using substantial force or a designated removal method.

A lockout is achieved by:

- De-energizing the circuit using the energy isolating device and placement of a lockout device in accordance with an established procedure, ensuring that energy isolating device and equipment being controlled cannot be re-energized until the lockout device is removed.
- Must include a tag with the name and contact information of the person authorized to remove the lockout device, that is unambiguously attached to the lockout device. Only the person whose name is on the tag is authorized to remove the lockout device.
- In the event of a shift change, both the person leaving and the person incoming must be present and familiar with the details of the work being performed and trained in lockout procedure to transfer responsibility.

What is a tagout device?

- A non-reusable¹ tag with identifying information.
- Substantial enough to prevent inadvertent or accidental removal.
- Attachable by hand, self-lockable.
- Unambiguously attached to the energy isolating or lockout device.

Tagout is achieved by:

- Placing a tag on an energy isolating device in accordance with the established procedure, to indicate that energy isolating device and equipment controlled by it may not be operated until the tagout device is removed.
- May only be used in place of lockout if the established procedure has a 100% safety track record.

WARNING!

- Tags provide a false sense of security!
- Warning devices do not provide physical restraint that a lock would.
- Everyone in the vicinity of the tag needs to be properly trained in order for the tag to be effective!
- The tag must be legible / understandable, and must be attached securely.
- The tag must withstand the environmental conditions.



Lockout and tagout devices must identify the employee applying the devices!



Lockout/tagout procedure:

- Notify the employees affected that the circuit is being de-energized, but is not yet safe to work on.
- Verify that the circuit to be locked out is energized with a hot-stick or multimeter at the location of work to be performed. (to identify and verify that the proper circuit is being locked out)
- De-energize the circuit using the correct procedure.
- Verify that the circuit has been de-energized with a hot-stick or multimeter at the location of work to be performed.
- If shared neutral is found, verify that no current is present in the neutral lead closest to the panel / home run with a clamp meter. If a current is present, additional circuits may need to be locked out to insure employee safety.
- Apply the lockout device and tag.
- Verify that the circuit has remained de-energized at the area of work.
- Notify the affected employees that the circuit is safe to work on.

WARNING!

- Even when the circuit has been de-energized, certain hazards can remain, due to the fact that it is not possible to know if all the wiring on site was installed correctly.
- While it is generally safe to work on the circuit that has been locked out, attention must be paid to the neutral wiring, which may be shared with other circuits. Even if no load was present on the shared circuit during the lockout procedure, it is not an absolute guarantee.



Removal of lockout/tagout procedure:

- Notify everyone in the affected area that the lockout device is about to be removed and the circuit is to be re-energized.
- Verify that all the work has been completed, and all the circuit junctions are safe.
- Verify that all the affected employees are aware that the circuit is to be re-energized.
- Remove the lockout device. **(WARNING! LOCKOUT DEVICE TO BE REMOVED ONLY BY THE PERSON WHO INSTALLED IT!)**
- Re-energize the circuit.
- Verify that the circuit and the affected devices are operating as desired.

¹ *The OSHA guide possibly contains an error. The tag itself is usually reusable, however, the attachment method should be non-reusable. For example, you cannot use a tie wire, duct tape or a bolt/screw to attach a tag, something like a zip-tie is preferred. Most of the tags found in the field are indeed reusable (laminated) and can be erased with an alcohol wipe. Another attachment method that can be used is to thread the tag through the lock clasp. While this method is reusable, it is a valid method. Some project specific rules and guidelines can overrule the type of the tag used for Tag-Out.*



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Personal Protective Equipment (PPE)

Eye Protection

- Always required
- ESLE will provide your first pair of safety goggles, and replacements thereafter at a predetermined interval. Also, a replacement pair will be provided if the goggles get damaged while protecting you on the job (incident report required). If a replacement pair is needed due to other reasons, it will be provided at your expense.

Foot Protection

- **Steel toe boots are your own responsibility.** ~~ESLE will provide a rebate up to \$150 after the 3rd month of employment (receipt required).~~ ***please give us suggestions***

Headgear

- A hard hat will be provided by ESLE as needed for the job. A replacement will be provided on a predetermined basis. Also, a replacement will be provided if the hard hat is damaged while protecting you.

Hearing Protection

- Earplugs will be available on jobsite as needed. Please contact your supervisor on the job.
- Earbuds / Headphones are not replacements for hearing protection!

Gloves

- ESLE will provide gloves at a predetermined interval. Gloves can be exchanged by your foreman if you need replacements due to wear.

Arcsuit

- Will be provided as needed for the job.
- Hands-on training will be provided before the start of the project where a suit is required.

Dust Mask / Respirator

- Majority of our work does not require respiratory protection. You are free to use your own dust mask for comfort.
- If a job demands the use of respiratory protection, the respirators will be provided prior to job start, along with project specific training.

Fall Protection

- Fall protection harnesses, positioning belts, etc., will be provided by ESLE.

Specialized PPE

- When specialized PPE is required for the job, both the PPE, training, and rules will be provided prior to start of the project.



Personal Protective Equipment (PPE)

additional PPE info placeholder

end section

OSHA REGULATIONS PART VII – Personal Protective Equipment

Section 86 (1) (2) - Use of equipment required states: Where it is not reasonably practicable to protect the health and safety of workers by design of the plant and work processes, suitable work practices or administrative controls, an employer or contractor shall ensure that every worker wears or uses suitable and adequate personal protective equipment, and further states; Where personal protective equipment will not effectively protect a worker, an employer or contractor shall, where reasonably practicable, provide alternative work arrangements for that worker. **Section 87 - General responsibilities** lays out the responsibilities of an employer or contractor to their workers in regards to the supply, use, care and maintenance of PPE at the worksite.



Executive Policy Statement

Our goal is to have zero accidents and injuries. This comes with great commitment but for a worthy cause. Employees are our most valuable asset. Therefore, safety is of prime importance on every project.

Everyone must do their part. The management will provide proper procedures, equipment and training. The employees must follow those procedures, work safely, and provide further feedback for continuous improvement. Company success depends on safety just as much as it does on production and revenue. We will not compromise employees, customers or public safety to meet a deadline. Your full cooperation is expected in making this program effective.

Do not perform work if you feel it is not safe to do so.

General Practices

1. All persons shall follow these safe practices rules, render every possible aid to safe operations, and report all unsafe conditions or practices to the foreman or superintendent.
2. Foremen shall insist on employees observing and obeying every rule, regulation, and order as is necessary to the safe conduct of the work and shall take such action as is necessary to obtain observance.
3. All employees shall be given frequent accident prevention instructions. Instructions shall be given at least every 10 working days. When applicable, the accident prevention instructions shall also include specific instruction on the safe use, care and maintenance of fall protection equipment (i.e. fall arrest systems, positioning device systems, safety nets, etc.) used at the jobsite.



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4. Anyone known to be under the influence of drugs or intoxicating substances which impair the employee's ability to safely perform the assigned duties shall not be allowed on the job while in that condition.
5. Horseplay, scuffling, and other acts which tend to have an adverse influence on the safety or well-being of the employees shall be prohibited.
6. Work shall be well planned and supervised to prevent injuries in the handling of materials and in working together with equipment.
7. No one shall knowingly be permitted or required to work while the employee's ability or alertness is so impaired by fatigue, illness, or other causes that it might unnecessarily expose the employee or others to injury.
8. Employees shall not enter manholes, underground vaults, chambers, tanks, silos, or other similar places that receive little ventilation, unless it has been determined that it is safe to enter.
9. Employees shall be instructed to ensure that all guards and other protective devices are in proper places and adjusted and shall report deficiencies promptly to the foreman or superintendent.
10. Crowding or pushing when boarding or leaving any vehicle or other conveyance shall be prohibited.
11. Workers shall not handle or tamper with any electrical equipment, machinery, or air or water lines in a manner not within the scope of their duties, unless they have received instructions from their foreman.
12. All injuries shall be reported promptly to the foreman or superintendent so that arrangements can be made for medical or first aid treatment.
13. When lifting heavy objects, the large muscles of the leg instead of the smaller muscles of the back shall be used.
14. Inappropriate footwear or shoes with thin or badly worn soles shall not be worn.
15. Materials, tools, or other objects shall not be thrown from buildings or structures until proper precautions are taken to protect others from the falling objects.
16. Employees shall cleanse thoroughly after handling hazardous substances and follow special instructions from authorized sources.



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17. Avoid the use of extension ladders when carrying loads. Such ladders may provide adequate strength, but the rung position and rope arrangement make such climbing difficult and hazardous for this trade.
18. Work shall be so arranged that employees are able to face ladder and use both hands while climbing.
19. Gasoline shall not be used for cleaning purposes.
20. No burning, welding, or other source of ignition shall be applied to any enclosed tank or vessel, even if there are some openings, until it has first been determined that no possibility of explosion exists, and authority for the work is obtained from the foreman or superintendent.
21. Any damage to scaffolds, falsework, or other supporting structures shall be immediately reported to the foreman and repaired before use.

Tools and Equipment Practices

22. All tools and equipment shall be maintained in good condition.
23. Damaged tools or equipment shall be removed from service and tagged "DEFECTIVE."
24. Pipe or Stills on wrenches shall not be used as a substitute for other wrenches.
25. Only appropriate tools shall be used for the job.
26. Wrenches shall not be altered by the addition of handle-extensions or "cheaters."
27. Files shall be equipped with handles and not used to punch or pry.
28. A screwdriver shall not be used as a chisel.
29. Wheelbarrows shall not be pushed with handles in an upright position.
30. Portable electric tools shall not be lifted or lowered by means of the power cord. Ropes shall be used.
31. Electric cords shall not be exposed to damage from vehicles.
32. In locations where the use of a portable power tool is difficult, the tool shall be supported by means of a rope or similar support of adequate strength.



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Machinery and Vehicles Practices

33. Only authorized persons shall operate machinery or equipment.
34. Loose or frayed clothing, or long hair, dangling ties, finger rings, etc., shall not be worn around moving machinery or other sources of entanglement.
35. Machinery shall not be serviced, repaired or adjusted while in operation, nor shall oiling of moving parts be attempted, except on equipment that is designed or fitted with safeguards to protect the person performing the work.



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Overload Protection / Protection Devices

The purpose of this document is to help you identify protection devices, be able to recognize if the application is correct, and be able to identify a correct replacement shall a need arise.

Glass Fuse:

- A glass tube with a small wire on the inside, suitable for low voltage applications.
- Can be fast action or slow blow. (letter **F** in the part number stands for fast, while letter **T** stands for slow or "time delay")



HRC (High Rupture Capacity) Fuse

- A ceramic tube filled with sand to absorb the energy in event of overcurrent.
- Can be fast action or slow blow.
- Sometimes uses an indication or trip mechanism to show fault or trigger disconnect.
- Smaller fuses are often very similar to the glass fuse above, except have a white ceramic tube instead of glass tube.



Dropout / Explosive Fuse

- Used in high voltage applications.
- Current sink side is ejected during a fault condition to break high voltage overcurrent condition and prevent prolonged arcing inside the fuse.



Electronic Explosive / Safety Terminal

-
- A small charge is electronically detonated to physically separate the conductor from the terminal when a fault condition or an accident is detected.
- Used most often in automotive application.





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Overload Protection / Protection Devices

Low Voltage Fuse

- Plastic enclosed low voltage fuses.
- Mostly used in automotive application.
- This type of fuse is only suitable for very low voltages, like 12V or 24V.
- Should never be used for line voltage. *Using this type of fuse incorrectly will result in a fire.*



Poly / PTC Fuse

- Positive Thermal Coefficient (PTC) fuse has a low resistance when at room temperature. Normal operation does not cause an increase in temperature, keeping resistance low. In an overcurrent condition, the increased current causes the device to heat up, resulting in increased resistance, and therefore a higher amount of energy being dissipated by the fuse, increasing its resistance further, causing the fuse to absorb the current surge and protect the circuit.



Thermal Fuse (non-resettable)

- Thermal fuses use temperature rather than current to trip the fuse.
- Often used as final protection devices in motor windings and heating devices.
- Used as last chance protection against a fire hazard due to overcurrent.
- Protect the circuit, not the device.



Thermal Fuses – resettable

- Protect against over-temperature.
- Often used in motors and various other devices that are capable of producing high temperatures.
- Often used as thermostats in heating devices.





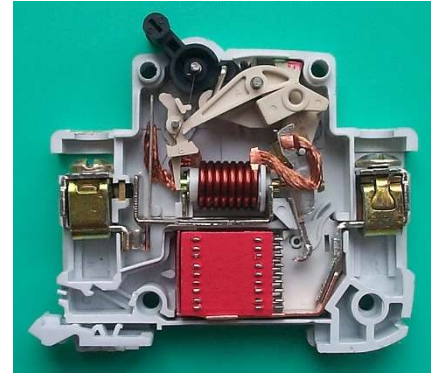
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Overload Protection / Protection Devices

Thermal-Magnetic Circuit Breaker

- Use a coil solenoid to trip the breaker in the event of short circuit.
- Uses a heater and a bi-metallic strip to trip the breaker in an event of overcurrent.
- Very common in both commercial and residential applications.



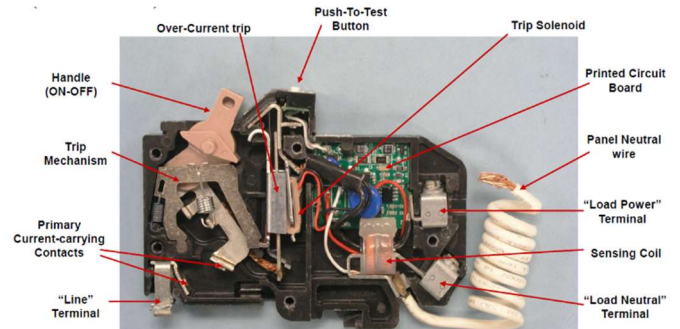
Electronic Trip Breaker

- This type of breaker is tripped by an electronic circuit that is monitoring the current.
- Commonly used in MDP (Main Distribution Panels) in commercial applications.
- Trip current is often adjustable, either by a potentiometer on the device, or by a replaceable “plug” containing the calibrated sense resistors.



GFCI – Ground Fault Connection Interrupter

- This type of breaker is monitoring the current on hot and neutral simultaneously, and if an imbalance is detected – the breaker is tripped.
- Usually internally paired with thermal circuit breaker.



AFCI – Arc Fault Connection Interrupter

- An electronic circuit is monitoring the high-frequency load (as would result from arcing), and if a fault condition is detected – the breaker is tripped.
- Is often combined with GFCI circuitry.
- Usually a part of thermal circuit breaker.





Shunt Trip Breaker

- Breaker that is tripped externally, by applying a voltage to a coil attached to the breaker.
- Usually paired with a thermal-magnetic mechanism for overcurrent protection.



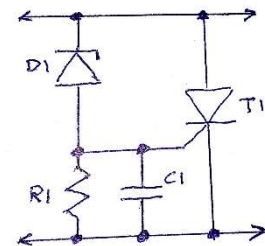
TVSS – Transient Voltage Surge Suppressor

- Used to suppress high voltage / high frequency spikes.
- Does not allow the voltage to exceed a predetermined value.
- Usually connected to MDP through a 3 pole 40A circuit breaker. *40A breaker will allow enough current to flow momentarily to suppress a high voltage transient / spike. This device does not provide long term overvoltage protection. An extended spike will likely trip the main breaker as well as the TVSS breaker, so it is really important to reset the TVSS breaker prior to resetting the main breaker in the aftermath of a transient trip event.*



Crowbar Circuit

- An electronic circuit designed to protect the device by shorting the input power and allowing the overcurrent device to trip. Is re-set by removing and reapplying the power.



Arrestor

- Design to absorb lightnings from transmission lines. Auto-resets after 1 cycle.





Measuring Voltage:

- **Make sure that your test leads are attached to the Voltage socket on the meter! If you are plugged in to Amp socket – your meter is a dead short, and will cause a short circuit as soon as you touch the voltage source you’re measuring! This could also result in an arflash!**

When measuring voltage, you first need to determine if you are measuring AC or DC voltage. If you’re measuring building wiring, it is most likely AC. If you’re measuring vehicle voltage, solar panel voltage, or led driver output voltage – it is most likely DC. Another important step is to select the correct range for the measurement. If unsure, start with a higher range, and then select a lower voltage as needed. If you measure a 12V source while in 200V range – you’ll have lower accuracy, but if you measure 480V source in 20V range – you’ll have an exploded multimeter, and will be lucky if you don’t also get injured and damage property.

Measuring Continuity:

- **Make sure that the circuit you’re testing is de-energized! Failure to do so will damage the multimeter and may kill you!**

When trying to identify an unlabeled group of wires, start by connecting all the wires except one together at one end of the conduit, and identify the unconnected wire as #1, then ring the wires on the other end. Once you find the wire that does not ring with any other wires, identify it as #1. Once you have the first wire identified, connect other wires to it one by one, and see which rings on the other end. Once you find the one that rings – identify it incrementally at both ends, until all wires are identified and labeled.

If there is a suspicion that the wires may be damaged, test the continuity will all the wires disconnected first, to make sure the wires are not shorted inside the conduit. For metal conduit, test the continuity to the conduit as well.

Measuring Current:

- **Do not measure AC current with a multimeter, always use an Amp Clamp for AC current!**
- **Never put the leads in parallel with the load! Never measure a current source without a load!**

When measuring DC current (for example: to identify a LED driver), put the meter in series with the load. Make sure to return the test leads back to the Voltage position once you’re done measuring current (Amps)! Failure to do so may result in death!

Multimeters and clamp meters often exist as a single unit that has functionality of both. In this document, these functions are addressed as separate devices, so the references to “multimeter” will refer only to functionality that works through the test leads, and the references to “amp clamp” will refer only to the functionality of the clamp.

amend with video link



Measuring Current:

Make sure the meter is set to the correct range and type of current you're measuring. If your clamp is capable of DC current measurement, make sure that the correct mode is selected for AC or DC measurement. Make sure that only the supply lead is going through the clamp loop (if both hot and neutral are in the loop, the current will be coming in over one wire, and returning over the other, so you will not be able to measure it). If the current is too low, you can wrap the wire around the loop several times, however, you will need to divide the result by the number of turns around the loop.

Measuring Inrush Current:

Some meters have a capability to measure the inrush current. To use this feature, set your meter to inrush mode, switch off the load, attach the clamp around the wire, then switch on the load. Your meter should register the max inrush current.

Measuring Leakage Current:

To measure the leakage current (i.e. a short to ground somewhere in the circuit, or a second circuit loading a neutral), put the clamp around both hot and neutral of the circuit you're measuring (but not the ground). Your meter should read zero (or very close to zero, due to environmental noise). If you get a reading other than zero, switch off the circuit you're measuring, and measure neutral only. If you are reading a load, then there is leakage to this neutral from another circuit. If you're reading zero – there is leakage to ground somewhere on the circuit you're measuring.

Measuring Leakage Current on 2-Pole Circuits:

2-Pole circuits can be measured in a similar way, just attach the clamp around 2 phase wires instead of hot/neutral. If the reading is zero – there is no leakage current. A reading other than zero indicates a leakage to ground. Subsequently, the phases can be measured individually to compare the load and narrow down which side has the problem.

Measuring Load Balance:

On a 3-pole breaker with shared neutral, you can put a clamp around all 3 phases at once, to measure load balance. If you are reading 0 – the load is perfectly balanced. However, it is still recommended that all 3 phases are measured separately, because you'll also read zero on a 2-phase load that is not connected to neutral.

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Power Tool / Hand Tool Safety

Overview of OSHA3080 (Full booklet is available on OSHA's website)

Tools are such a common part of our lives that it is difficult to remember that they may pose hazards. Tragically, a serious incident can occur before steps are taken to identify and avoid or eliminate tool-related hazards.

Employees who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and splashing objects, or to harmful dusts, fumes, mists, vapors, or gases must be provided with the appropriate personal protective equipment. All electrical connections for these tools must be suitable for the type of tool and the working conditions (wet, dusty, flammable vapors). When a temporary power source is used for construction a ground-fault circuit interrupter should be used.

Employees should be trained in the proper use of all tools. Workers should be able to recognize the hazards associated with the different types of tools and the safety precautions necessary.

Five basic safety rules can help prevent hazards associated with the use of hand and power tools:

1. Keep all tools in good condition with regular maintenance.
2. Use the right tool for the job.
3. Examine each tool for damage before use and do not use damaged tools.
4. Operate tools according to the manufacturers' instructions.
5. Provide and use properly the right personal protective equipment.

Employees and employers should work together to establish safe working procedures. If a hazardous situation is encountered, it should be brought immediately to the attention of the proper individual for hazard abatement.

Requirements:

Tools used by ESLE employees are required to have following protective measures when applicable.

- Guards:
 - Original tool guards must not be removed.
- Controls / Switches:
 - Original controls / switches must be unmodified and functional.
- Power Cords:
 - Power cords must be free of damage, and ground pin must be present on 3 prong plugs.
- Insulation:
 - Insulated screw drivers and pliers must have the handles and insulation intact. If the insulation is damaged, the tool may not be used.



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Ladder & Scaffold Safety

use osha ladder scaffold safety module



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Fall Protection / Personal Fall Arrest Systems

use osha fall protection training