

# Electrical Level 1



Electrical Safety 26102-14



# Objectives

**When trainees have completed this session, they should be able to do the following:**

1. Recognize safe working practices in the construction environment.
2. Explain the purpose of OSHA and how it promotes safety on the job.
3. Identify electrical hazards and how to avoid or minimize them in the workplace.
4. Explain electrical safety issues concerning lockout/tagout procedures, confined space entry, respiratory protection, and fall protection systems.
5. Develop a task plan and a hazard assessment for a given task and select the appropriate PPE and work methods to safely perform the task.



# Performance Tasks

1. Perform a visual inspection on various types of ladders.
2. Set up a ladder properly to perform a task.
3. Properly don a harness.
4. Perform a hazard assessment of a job such as replacing the lights in your classroom.
  - Discuss the work to be performed and the hazards involved.
  - Locate the phone closest to the work site and ensure that the local emergency telephone numbers are either posted at the phone or known by you and your partner(s).
  - Plan an escape route from the location in the event of an accident.



# 1.0.0

## What's wrong with this picture?



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## 2.0.0

# Electrical Shock

- The most life-threatening hazards on a construction site are falls, being crushed by falling materials or equipment, electric shock, and being struck by flying objects or moving equipment. Most accidents are preventable if safety precautions are followed.
- Effects of electrical contact include heart fibrillation, cardiac arrest, and burns.

**Table 1** Current Level Effects on the Human Body

Current Value	Typical Effects
1mA	Perception level. Slight tingling sensation.
5mA	Slight shock. Involuntary reactions can result in serious injuries such as falls from elevations.
6 to 30mA	Painful shock, loss of muscular control.
50 to 150mA	Extreme pain, respiratory arrest, severe muscular contractions. Death possible.
1000mA to 4300mA	Ventricular fibrillation, severe muscular contractions, nerve damage. Typically results in death.

Source: Occupational Safety and Health Administration

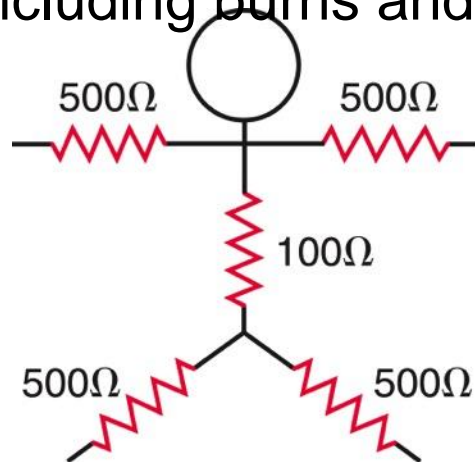
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## 2.1.0 – 2.1.2

# Body Resistance

- Shock occurs when the body becomes part of an electric circuit.
- The effects of electric shock depend on the amount of current, its path through the body, and the length of exposure.
- Shocks often result in internal burns or bleeding, and other injuries including burns and falls.



- HAND TO HAND 1000 OHMS
- 120 VOLT
- FORMULA:  $I = E/R$
- $120/1000 = 0.120$  AMPS  
OR 120 MILLIAMPS

# 3.0.0

## Reducing Your Risk

- Limited approach boundaries have been established to provide minimum safe clearance distances to live parts.
- Only trained and qualified individuals may cross a limited approach boundary.
- Always follow company safety policies as well as OSHA and NFPA standards.

**Table 2** Limited Approach Boundaries to Live Parts

Nominal System Voltage Range (Phase-to-Phase)	Limited Approach Boundary from Fixed Circuit Component
50 to 300	3 ft 6 in
301 to 750	3 ft 6 in
751 to 15kV	5 ft 0 in
15.1kV to 36kV	6 ft 0 in
36.1kV to 46kV	8 ft 0 in
46.1kV to 72.5kV	8 ft 0 in
72.6kV to 121kV	8 ft 0 in
138kV to 145kV	10 ft 0 in
161kV to 169kV	11 ft 8 in
230kV to 242kV	13 ft 0 in
345kV to 362kV	15 ft 4 in
500kV to 550kV	19 ft 0 in
765kV to 800kV	23 ft 9 in

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## 3.1.0

# Protective Equipment

- *OSHA CFR 1910.335(a)* lists requirements for protective equipment.
- Personal protective equipment must be worn wherever there is a risk of electrical hazards.



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## 3.1.1 – 3.3.0

# Equipment Inspection and Safety Precautions

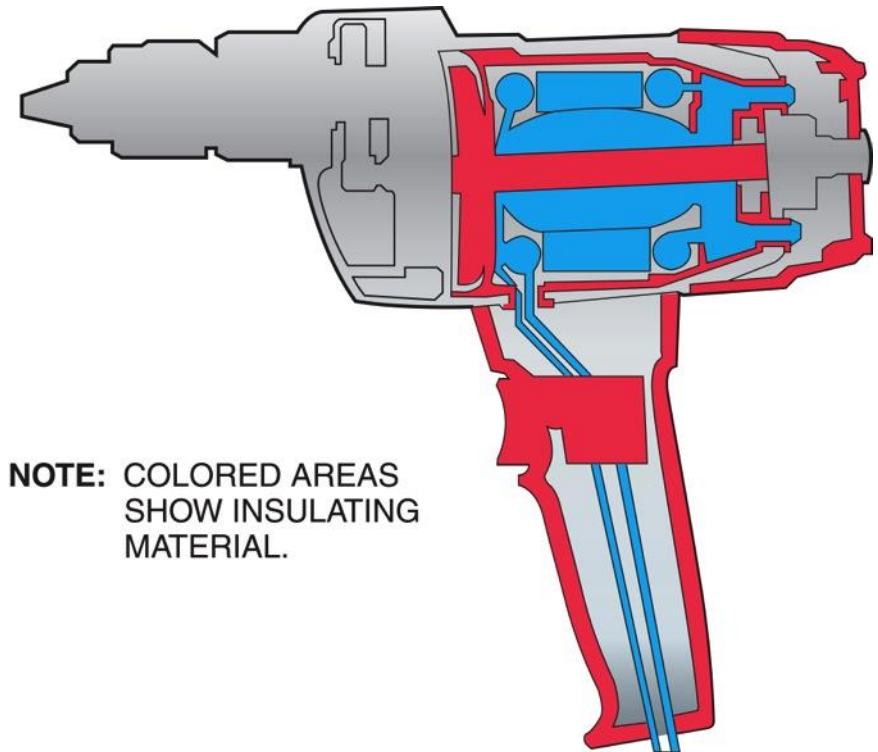
- Rubber protective equipment is color coded by voltage class. Daily inspection and biannual testing are necessary to ensure safety.
- Other protective equipment includes hot sticks, fuse pullers, shorting probes, and eye/face protection.
- Always verify the absence of voltage before working on a circuit (live-dead-live test).
- Never work outside of the planned scope. Stop and reassess safety first.



## 4.0.0 – 5.0.0

### OSHA; NFPA 70E®

- The purpose of OSHA is to ensure a safe and healthy working environment.
- OSHA publishes many standards, including *CFR 1910*, for general industry, and *CFR 1926*, for the construction industry.
- OSHA electrical regulations require that all tools be either grounded or double-insulated.



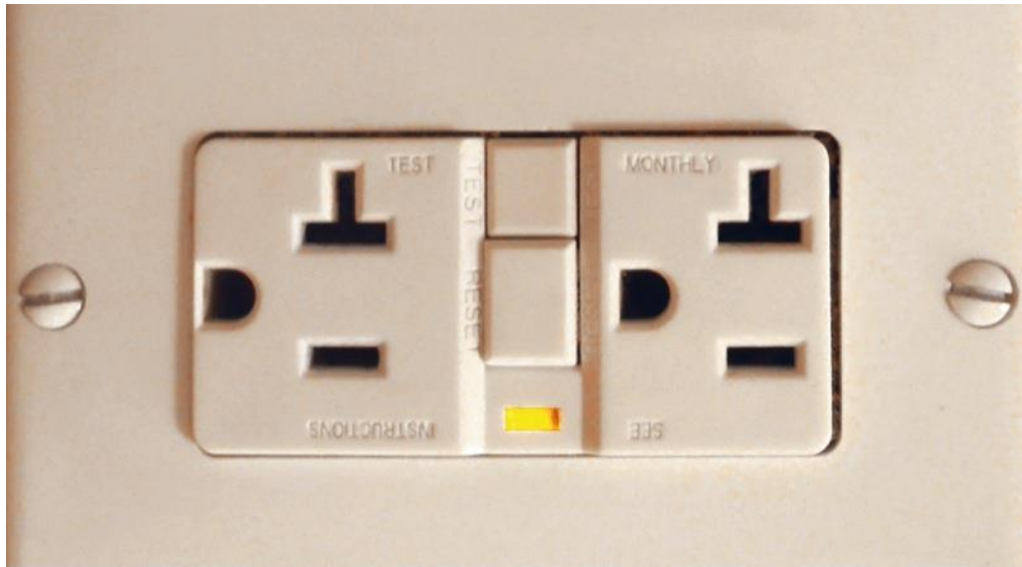
**NOTE:** COLORED AREAS SHOW INSULATING MATERIAL.

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## 4.0.0 – 5.0.0

# Typical GFCI Receptacle

- Receptacles other than 125V, single-phase, 15A, 20A, and 30A should be ground fault protected if possible.
- In lieu of a GFCI receptacle, an assured equipment grounding conductor program must be in place.



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# 4.0.0 – 5.0.0



(A) ELECTRICAL LOCKOUT



(B) PNEUMATIC LOCKOUT

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## OSHA Lockout/Tagout Rule

- All sources of energy must be locked out and tagged prior to equipment service or maintenance. This includes all sources of electric, mechanical, hydraulic, thermal, and chemical energy.
- Always follow the lockout/tagout procedure for the specific job site.

## 4.0.0 – 5.0.0



# Multiple Lockout/ Tagout Device

- Each authorized employee must affix a separate lock and key.
- OSHA has specific procedures that must be followed for emergency removal of a lockout/tagout device.
- In addition to OSHA regulations, employers/employees must understand and follow the requirements of *NFPA 70E*®.

4.0.0 – 5.0.0

Next Session... *What's wrong with this picture?*

# Ladders and Scaffolds; Lifts, Hoists, and Cranes



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## 6.0.0 – 7.0.0

# Ladders and Scaffolds; Lifts, Hoists, and Cranes

- Ladders must be inspected before each use.
- Never climb a damaged ladder.



(A) CRUMBLING RAIL



(B) CRACKED STEPLADDER



(C) BENT BACK BRACE

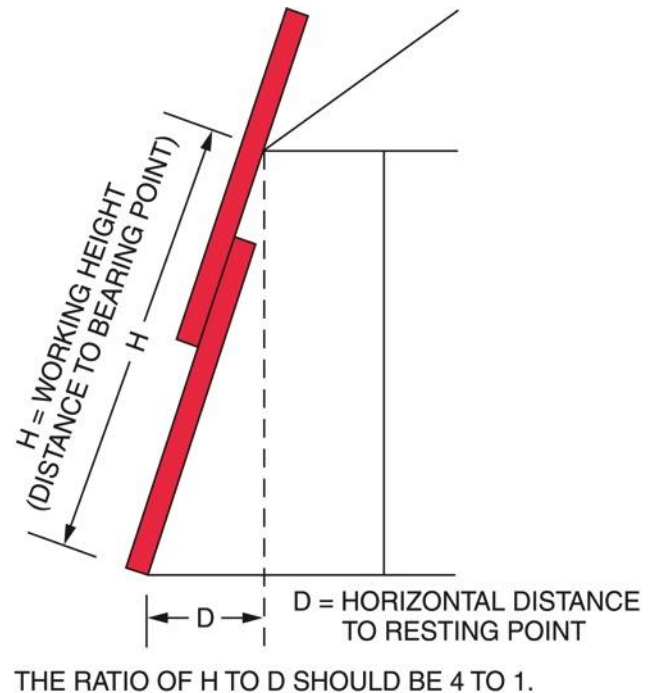
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# 6.0.0 – 7.0.0

## Ladder Positioning

- When positioning a straight ladder, the horizontal distance from the ladder feet to the wall should be one-fourth the working height of the ladder. Side rails should extend beyond the top support by 36 inches.
- Always lock the spreaders on a stepladder and never stand on the top two rungs.



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## Performance Tasks

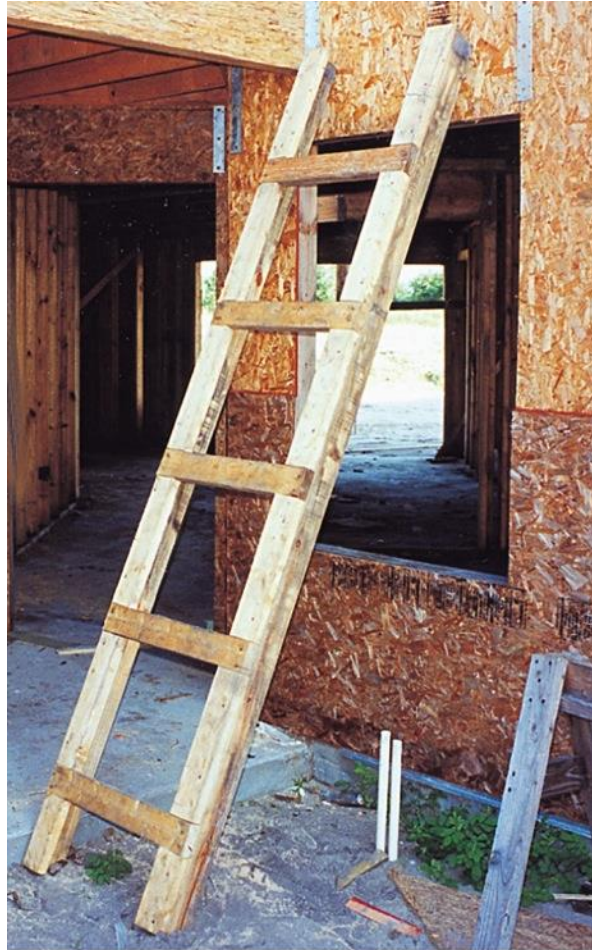
**Perform a visual inspection on various types of ladders and set up a ladder properly to perform a task.**

This session will conclude with trainees performing a visual inspection on various types of ladders and setting up a ladder properly to perform a task.



6.0.0 – 7.0.0

**What's wrong with this picture?**



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## 6.0.0 – 7.0.0

# Scaffolding and Lift Equipment

- Scaffolding must be erected and inspected by qualified individuals. It must be straight and plumb, with a sound footing and proper decking, toeboards, and guardrails.
- Exercise extreme caution when working in the vicinity of lifts, hoists, and cranes. Never assume that the operator can see you. Never stand or walk under a load.



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6.0.0 – 7.0.0

## What's wrong with this picture?



26102-14\_SA08.EPS



# 8.0.0

## Lifting

- Always lift with your legs, not your back.
- Avoid lifting objects over your head.
- Ask for help with heavy loads.
- Never lift over the side or tailgate of a pickup truck.
- Go around obstructions when carrying a load.
- Never step over objects.



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## 8.0.0

# What's wrong with this picture?



26102-14\_SA10.EPS

# 9.0.0 – 9.1.0

## Basic Tool Safety

- Only use tools for their intended purpose.
- Inspect tools regularly. Repair or replace damaged tools.
- Keep tools sharp.
- Wear protective equipment when using hand tools.



(A) HAMMER



(B) RATCHET CABLE CUTTER



(C) SCREWDRIVERS



(D) MULTI-PURPOSE TOOL

26102-14\_F12.EPS

## 9.2.0

# Next Session... Power Tool Safety

- Power tools can be operated using electricity, pneumatics, liquid fuels, or hydraulic energy.
- Never operate any tool unless you are qualified to do so. Follow the manufacturer's instructions for use and maintenance.
- Never alter or defeat the safety equipment on a power tool.
- Wear protective equipment when using power tools.

## Confined Space Entry Procedures; First Aid



26102-14\_F13.EPS

# 10.0.0 – 11.0.0

## Confined Space Entry Procedures; First Aid

- A confined space has a limited means of entry and exit and may contain a hazardous atmosphere or engulfment hazard. Confined spaces may be permit required or non-permit required. Confined-space entry requires a formal hazard review and rescue plan.
- Emergency numbers must be readily available on every job site.



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# 12.0.0 – 16.0.0

## Next Session... Solvents and Toxic Vapors; Asbestos; Batteries; PCBs and Vapor Lamps; Lead Safety

- All materials that present health hazards must have a safety data sheet (SDS) on site that lists PPE and safe use, storage, and disposal instructions.
- Common hazardous materials include solvents, asbestos, batteries, PCBs, and lead.
- Wear all appropriate PPE, including respiratory protection, when working near toxic materials.

## Fall Protection

HAZARD: May cause drowsiness or dizziness. (DANGER) May form explosive peroxide. (DANGER) Can irritate in a well-ventilated place. Keep container tightly closed. (DANGER) Dispose of contents/container in accordance with local regulation.

**SECTION 3 - COMPOSITION/INFORMATION ON INGREDIENTS**

	CAS#	EC#	REACH Pre-registration Number	CONCENTRATION % by Weight
Tetrahydrofuran (THF)	109-99-9	203-726-8	05-2116297729-02-0000	25 - 50
Methyl Ethyl Ketone (MEK)	78-93-3	201-108-0	05-2116297729-04-0000	5 - 36
Cyclohexanone	108-94-1	203-631-1	05-2116297718-05-0000	15 - 30

All of the constituents of this adhesive product are listed on the TSCA inventory of chemical substances maintained by the US EPA, or are exempt from that listing. \* Indicates this chemical is subject to the reporting requirements of Section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (40CFR372). # Indicates that the chemical is found on Proposition 65's List of chemicals known to the State of California to cause cancer or reproductive toxicity.

**SECTION 4 - FIRST AID MEASURES**

Contact with eyes: Flush eyes immediately with plenty of water for 15 minutes and seek medical advice immediately.

First Aid: If inhaled: Remove to fresh air. If breathing is stopped, give artificial respiration. If breathing is difficult, give oxygen. Seek medical advice. If swallowed: Give 2 glasses of water or milk to dilute. Do not induce vomiting. Seek medical advice immediately.

Fire: Extinguish with water spray or stream. Avoid breathing fumes. Use self-contained breathing apparatus or full-face positive pressure airway mask.

Health: 2  
Flammability: 3  
Reactivity: 0  
PPE: B

HMIS: 2  
NFPA: 2  
GHS: 0-Minimal  
1-Slight  
2-Moderate  
3-Serious  
4-Severe

**SECTION 6 - ACCIDENTAL RELEASE MEASURES**

Personal precautions: Keep away from heat, sparks and open flame. Provide sufficient ventilation, use explosion-proof exhaust ventilation equipment or wear suitable respiratory protective equipment. Prevent contact with skin or eyes (see section 8).

Environmental Precautions: Prevent product or liquids contaminated with product from entering sewers, drains, soil or open water course.

Methods for Cleaning up: Clean up with sand or other inert absorbent material. Transfer to a closable steel vessel.

Materials not to be used for clean up: Aluminum or plastic containers.

**SECTION 7 - HANDLING AND STORAGE**

Handling: Avoid breathing of vapor, avoid contact with eyes, skin and clothing. Keep away from ignition sources, use only electrically grounded handling equipment and ensure adequate ventilation/fume exhaust hoods. Do not eat, drink or smoke while handling.

Storage: Store in ventilated room or shade below 44°C (110°F) and away from direct sunlight. Keep away from ignition sources and incompatible materials, caustics, ammonia, inorganic acids, chlorinated compounds, strong oxidizers and isocyanates. Follow all precautionary information on container label, product bulletins and solvent containing literature.

**SECTION 8 - PRECAUTIONS TO CONTROL EXPOSURE / PERSONAL PROTECTION**

Component	ACGIH TLV	ACGIH STEL	OSHA PEL	OSHA STEL
Tetrahydrofuran (THF)	50 ppm	100 ppm	200 ppm	300 ppm
Methyl Ethyl Ketone (MEK)	200 ppm	300 ppm	200 ppm	300 ppm
Cyclohexanone	50 ppm	100 ppm	200 ppm	300 ppm

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# 17.0.0 – 17.1.3

## Fall Protection

- All employees must receive annual training in fall protection when there is the possibility that they will be exposed to a fall of six feet or more.
- Fall protection may include guardrails, personal fall arrest systems (PFAS), or controlled access zones.



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# 17.0.0 – 17.1.3

## Complex Guardrail System

OSHA has specific construction requirements for guardrail systems.



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# 17.0.0 – 17.1.3

## What's wrong with this picture?



# 17.0.0 – 17.1.3

## Personal Fall Arrest Systems (PFAS)

- PFAS equipment must be worn when working 6 feet or more above the ground. It consists of a full-body harness, lanyards, and one or more anchor points.
- PFAS equipment must be inspected before each use and discarded if involved in a fall.

TIE OFF SEPARATE LANYARDS TO DIFFERENT D-RINGS



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# 17.0.0 – 17.1.3

## What's wrong with this picture?



26102-14\_SA13.EPS



# 17.0.0 – 17.1.3



RETRACTABLE  
LANYARD

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## Proper Fall Protection on a Boom Lift

- Retractable lanyards keep the line out of the way for safety when close to the ground or in a tight area.
- Do not put a shock absorber in line with a retractable lanyard.

# 17.0.0 – 17.1.3

## What's wrong with this picture?



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# 17.0.0 – 17.1.3

## Required Free Lengths for Various Lanyards

- When assessing a location for fall protection, examine the space below to ensure that it is clear of any obstructions.
- Use *Table 3* to determine the minimum distance between any hazard/obstruction and the worker or attachment point.

**Table 3** Required Free Lengths for Various Lanyards

Lanyard Type	Lanyard Length	Shock Absorber Length	Average Worker Height	Safety Factor	Required Free Length
Standard 6' lanyard with 3.5' shock absorber	6'	3.5'	6'	3'	18.5'
New ANSI 6' lanyard with 4' shock absorber	6'	4'	6'	3'	19'
New ANSI 12' lanyard with 5' shock absorber	6' (12' freefall)	5'	N/A (accounted for by lanyard)	3'	20'



# 17.0.0 – 17.1.3

## Controlled Access Zone

- Controlled access zones are used where a guardrail cannot be attached to the building.
- A controlled access zone must be located a minimum of six feet from the edge.



SIX FEET FROM EDGE

26102-14\_F20.EPS

### Performance Task

**Properly don a harness and perform a hazard assessment.**

This session will conclude with practicing properly donning a harness and performing a hazard assessment of a job.

# Wrap Up

## 3-2-1

- 3 – Write 3 important things learned during class
- 2 – Write 2 questions you have about the material
- 1 – Write 1 thought you had about the material



# Next Session...

## MODULE EXAM

Review the complete module to prepare for the module exam. Complete the Module Review as a study aid.

