

ELECTRICAL SAFETY

OCCUPATIONAL SAFETY AND HEALTH MANUAL



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ELECTRICAL SAFETY

[OAR 437, Division 2, Subdivision C](#)

This Electrical Safety Program was established to provide the maximum protection to our employees whenever they must work around any electrical hazards.

Employees involved in the maintenance, repair, and servicing of equipment that requires electrical energy or that work around overhead or underground electrical lines must follow these guidelines.

Note: Please also refer to the lockout/tagout program when completing work on equipment and machinery.

GENERAL RESPONSIBILITIES

Direct Supervisor: The Direct Supervisor is responsible for overall policy implementation and working with the Safety Committee and employees. The Direct Supervisor is also responsible to oversee completion of periodic audits and an annual policy review. In order to protect employees from hazards when working with electrical equipment, tools and appliances the Direct Supervisor must:

1. Inspect all electrical equipment to make sure the equipment is safe.
2. Require that all electrical equipment is used for its approved or listed purpose.
3. Require that all electrical equipment used or located in wet or damp locations is designed for such use.
4. Identify disconnecting means (see also lockout/tagout program).
5. Maintain electrical fittings, boxes, cabinets and outlets in good condition.
6. Maintain all flexible cords and cables in good condition and use safely.
7. Guard electrical equipment to prevent employees from electrical hazards.
8. Require that all electrical equipment be effectively grounded.
9. Require that all electrical equipment have overcurrent protection.

Authorized Employees: Only workers and supervisors who have received special training to recognize and understand the particular hazards involved with the tasks to be performed and the type/magnitude of electrical hazards are authorized to implement the procedure.

Affected Employees: An affected employee is one whose job requires them to perform maintenance on items powered by electrical energy, or that performs work around areas with overhead and/or underground electrical lines.

Training: A key component of this program is employee training. It is the supervisor's responsibility to see that all employees exposed to electrical hazards are trained on working around them. The authorized employees are

to receive additional specialized training as outlined in this program. The training must be documented by the Direct Supervisor.

INSPECTION OF ELECTRICAL EQUIPMENT

1. All electrical equipment must be inspected to make sure there are no recognized hazards likely to cause your employees' death or serious physical harm. Determine the safety of the equipment by using the following list:
2. Approved or listed by a recognized testing laboratory, such as Underwriters Laboratories (UL) or other certification agency.
3. Approved, or listed as approved, for the purpose it is being used.
4. Includes strong and durable guards that provide adequate protection, including parts designed to enclose and protect other equipment.
5. Has electrical insulation.
6. Won't overheat under conditions of use.
7. Won't produce arcs during normal use.
8. Classified by:
 - a. Type
 - b. Size
 - c. Voltage
 - d. Current Capacity
 - e. Specific Use
 - f. Other Factors

ENSURING APPROVED OR LISTED PURPOSE USE








Electrical Outlets: Places on an electric circuit where power is supplied to equipment through receptacles, sockets and out-lets for attachment plugs.

Receptacles: Outlets that accept a plug to supply electric power to equipment through a cord or cable.

Electrical outlets should be rated equal or greater to the electrical load supplied.

The proper mating configuration should exist when connecting the attachment plug to the receptacle.

When electrical outlets, cord connectors, and receptacles are joined, they should accept the attachment plug with the same voltage or current rating (see below graphic).

SOME COMMON ELECTRICAL OUTLET (RECEPTACLE) CONFIGURATIONS				
	15 Ampere	20 Ampere	30 Ampere	50 Ampere
Two Pole 3 - Wire Grounding 125 Volt				
Three Pole 3 - Wire 125/250 Volt				
Note: A 20-ampere "T-slot" outlet or cord connector may accept a 15-ampere attachment plug of the same voltage rating.				

ENSURE WET/DAMP LOCATIONS ARE DESIGNED FOR SUCH USE

- Fixtures and receptacles located in wet or damp locations must be approved for such use. They must be constructed or installed so that water cannot enter or accumulate in wire ways, lamp holders, or other electrical parts.
- Cabinets, fittings, boxes, and other enclosures in wet or damp locations should be installed to prevent moisture or water from entering or accumulating inside.
 - In wet locations, enclosures must be weatherproof.
 - Switches, circuit breakers, and switchboards located in wet locations must be in weatherproof enclosures.

MANUFACTURERS MARKINGS

Markings on electrical equipment must be durable and appropriate for the environment.

Appropriate markings include:

- The manufacturers name; or
- Trademark; or
- The organization responsible for the product; and
- Voltage, current, wattage or other ratings as necessary.

IDENTIFY MEANS OF DISCONNECTING

The disconnect means (such as on/off switches and circuit breakers) must be marked to show when it's open and closed, and what equipment it controls unless located and arranged so the purpose is obvious.

Each service, feeder and branch circuit should be marked at its disconnecting means or overcurrent device to show when the circuit is open/closed, and what circuit it controls (unless located and arranged so the purpose is obvious).

Markings on the disconnect should be durable and appropriate to the environment in which the disconnect is located.

FITTINGS, BOXES, CABINETS, AND OUTLETS

Openings and Covers

1. When conductors enter boxes, cabinets, or fittings, the following must be in place:
 - a. The conductor must be protected (i.e. the wires must be protected from abrasions).
 - b. Openings where conductors enter should be effectively closed so that the internal wiring is not exposed.
 - c. Any unused openings should be covered with blanks to ensure that employees are not exposed to the internal wiring.
2. Provide pull boxes, junction boxes, and fittings with covers approved for the purpose
3. Each outlet box must have a cover, faceplate, or fixture canopy in completed installations.
4. Covers for outlet boxes with openings for flexible cord pendants must have bushing to protect the cord, or have a smooth and well-rounded surface where the cord touches the opening.
5. Metal covers must be grounded.

Areas in front of electrical panels, circuit breaker boxes, and similar equipment which operate at 600 volts or less

1. Must have sufficient working area at least 30 inches wide for operational and maintenance of the equipment.
2. Must be kept clear and free of stored materials so that employees can access this equipment for servicing, adjustments, or maintenance.
3. Should have at least one access route that is free of obstructions.
4. Have at least 3 feet (36 inches) of working space in front from floor to ceiling (measured from the exposed live part or the enclosure front). Consider installing signage that states this requirement to ensure that the 3 feet clearing is maintained at all times (or marking the area with yellow paint).
5. Should have adequate indoor lighting for clear viewing of the area.
6. Have at least 6 feet 3 inches of headroom.

The table below shows the area to keep clear depending upon the layout of the electrical equipment

Conditions*	0-150 Volts to Ground	151-600 Volts to Ground
A	3 ft	3 ft
B	3 ft	3.5 ft
C	3 ft	4 ft

Minimum clear distances may be 0.7 m (2.5 ft) for installations built before April 16, 1981.

*Conditions A, B, and C are as follows:

A = Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating material. Insulated wire or insulated bus bars operating at not over 300 volts aren't considered live parts.

B = Exposed live parts on one side and grounded parts on the other side.

C = Exposed live parts on both sides of the workspace (not guarded as provided in condition (a) with the operator between the panels).

FLEXIBLE CORDS AND CABLES

Exemption: Rules do not apply to cords and cables that are an internal part of factory assembled appliances and equipment, like the windings on motors or wiring inside electrical panels.

1. You must perform a visual inspection of all flexible cords and cables on portable cord and plug connected equipment and extension cords before use on each work shift. It is not required that you visually inspect portable cord and plug connected equipment and extension cords that stay connected once in place and aren't exposed to damage until they are moved. Defects and damage to look for include:
 - a. Loose parts;
 - b. Deformed or missing pins;
 - c. External defects and damage;
 - d. Damage to the outer covering or insulation;
 - e. Pinched or crushed covering or insulation that might indicate internal damage
2. You must remove from service any defective or damaged cord until repaired and tested.
3. Make sure flexible cords and cables are used as described.
4. Use flexible cords only as follows:
 - a. Wiring of equipment and appliances;
 - b. Data processing cables approved as a part of the data process system;
 - c. Pendants;
 - d. Wiring for fixtures;

- e. Connecting portable lamps or appliances to an approved outlet with an attached plug;
 - f. Connecting stationary equipment that is frequently changed with an attachment plug energized from an approved outlet;
 - g. Preventing noise or vibration transmission;
 - h. Appliances that have been designed to permit removal for maintenance and repair if the appliance is equipped with an attachment plug energized from an approved outlet;
 - i. Elevator cables;
 - j. Wiring of cranes and hoists.
- 5. If additional power supplies are needed, utilize an approved surge protector with multiple outlets.
 - 6. Extension cords cannot be plugged into or piggybacked on to other extension cords or surge protectors.
 - 7. If the light on the surge protector is flickering or off, remove the surge protector from service. This flickering or absence of a light indicates that a power surge has gone through the surge protector, and it is no longer working appropriately.
 - 8. Cheater boxes plugged into electrical receptacles are not allowed.
 - 9. Flexible cords cannot be used in the following ways:
 - a. As a substitute for fixed wiring of a structure;
 - b. To run through holes in walls, ceilings, or floors;
 - c. To run through doorways, windows, or similar openings;
 - d. To attach to building surfaces;
 - e. To conceal behind building walls, ceilings, or floors;
 - f. To raise or lower equipment.
 - 10. Flexible cords and cables will be approved for conditions of use and location.
 - 11. Do not fasten or hang cords and equipment in any way that could cause damage to the outer jacket or insulation of the cord. Use tension relief devices.
 - 12. Insulation on flexible cords and cables must be intact.
 - 13. Flexible cords and electrical cords must be:
 - a. Connected to devices and fittings so that any pulling force on the cord is prevented from being transmitted to joints or terminal screws on the plug.
 - b. Used only in continuous lengths without splice or tap.
 - 14. Do not plug or unplug equipment or extension cords of equipment that is energized using wet hands.

TEMPORARY CORD USE

- 1. Temporary electrical power (such as extension cords) and lighting installations that operate at 600 volts or less are used only:
 - a. During and for remodeling, maintenance, repair or demolition of buildings and similar activities.
 - b. For experimental or development work.
 - c. For a period not to exceed 90 days for:
 - i. Christmas decorative lighting;
 - ii. Carnivals;
 - iii. Other similar purposes.
- 2. Flexible cords and electrical cords used on a temporary basis must be protected from accidental damage by avoiding sharp corners and projections, especially where they pass through doorways and other pinch points.

GUARD ELECTRICAL EQUIPMENT

- 1. Guard live parts of electrical equipment operating at 50 volts or more against accidental contact by any of the following means:
 - a. Approved cabinets or other forms of approved enclosures.

- b. By location in a room, vault or similar enclosure that is accessible only to employees qualified to work on the equipment. Entrances to rooms and other guarded locations containing exposed live parts must be marked with conspicuous warning signs forbidding unqualified persons from entering.
 - c. By permanent, substantial partitions or screens so that only employees qualified to work on the equipment will have access within reach of the live parts. Any openings must prevent accidental contact with live parts by employees or objects carried by employees.
 - d. By location on a balcony, gallery, or platform that will exclude unqualified personnel.
 - e. By being located 8 feet or more above the floor or other working surface.
- 2. All electrical appliances, fixtures, lamps, rosettes, and receptacles should not have live parts normally exposed to employee contact.
 - a. Rosettes and cleat type lamp holders at least 8 feet above the ground may have exposed parts.
- 3. In locations where electrical equipment would be exposed to physical damage, enclosure or guards must be so arranged and of such strength as to prevent such damage.

GROUND ELECTRICAL EQUIPMENT

- 1. The path to ground from circuits, equipment, and enclosures must be permanent and continuous.
- 2. Grounding prongs must not be removed from electrical cords and each electrical receptacle must provide a location for a ground prong. Cords without grounding prongs must not be used.
- 3. Equipment connected by cord and plug must be grounded under these conditions:
 - a. Equipment with exposed noncurrent carrying metal parts;
 - b. Cord and plug connected equipment which may become energized;
 - c. Equipment that operates at over 150 volts to ground;
 - d. Equipment in hazardous locations.
- 4. The following types of equipment must be ground:
 - a. Hand-held motor-operated tools;
 - b. Refrigerators;
 - c. Freezers;
 - d. Air conditioners;
 - e. Water fountains or water dispensing machines;
 - f. Clothes washers and dryers;
 - g. Electrical aquarium equipment;
 - h. Hedge clippers;
 - i. Electric lawn mowers;
 - j. Electric snow blowers;
 - k. Web scrubbers;
 - l. Tools likely to be used in damp or wet locations (i.e. in water or wastewater facilities);
 - m. Appliances used by employees standing on the ground, on metal floors, or working inside of metal tanks or boilers;
 - n. Portable hand lamps.
- 5. Grounding can be achieved by using tools and appliances equipped with an equipment grounding conductor (3 prong plug and grounded electrical system). Hand held tools and some types of equipment must use a 3-wire plug or the tool label must show the tool as insulated by words or symbol.
- 6. Exposed metal parts of fixed equipment that don't conduct electricity (but may become energized) must be grounded if the equipment is in a wet or damp location and isn't isolated.
- 7. Grounded wires must be identified and look different than the other conductors (wires).
- 8. Grounded conductors should not be attached to any terminal or lead to reverse polarity of the electrical outlet or receptacle.

9. Grounding terminals or grounding-type devices on receptacles, cords, connectors, or attachments plugs should not be used for purposes other than grounding.

OVERCURRENT PROTECTION

1. All electrical circuits that are rated at 600 volts or less must have overcurrent protection.
2. Protect conductors and equipment according to their ability to safely conduct electrical equipment.
3. Overcurrent devices should not interrupt the continuity of grounded conductors unless all conductors are opened at the same time, except for motor running overload protection.
 - a. Protect employees from electrical arcing or suddenly moving electrical parts by locating fuses and circuit breakers in safe places. If this isn't possible, install shields on fuses and circuit breakers.
4. The following fuses and thermo cutouts should have dis-connecting mechanisms:
 - a. All cartridge fuses accessible to nonqualified persons;
 - b. All fuses on circuits over 150 volts to ground;
 - c. All thermal cutouts on circuits over 150 volts to ground;
 - d. The disconnecting mechanism must be installed so you can disconnect the fuses or thermal cutouts without disrupting service to equipment and circuits unrelated to those protected by the overcurrent device.
5. Provide easy access to overcurrent devices for each employee or authorized building management personnel.
6. Protect the overcurrent devices by locating them away from easily ignitable materials.
 - a. They must be placed to avoid exposure to physical damage.
7. Circuit breakers:
 - a. Must clearly indicate when they are open (off) and closed (on).
 - b. That operate vertically must be installed so the handle is in the up position when the break is closed (on).
 - c. Used as switches in 120-volt, fluorescent lighting circuit must be approved for that purpose and marked "SWD".
 - d. That have arcing or suddenly moving parts should be shielded or located so employees won't get burned or injured by the operation of the circuit breaker.
8. Fuses that have arcing or suddenly moving parts must be shielded or located so employees won't get burned or injured by the operation of the fuses.

GROUND-FAULT CIRCUIT INTERRUPTERS (GFCI)

1. OAR 437-003-0404 requires ground-fault circuit interrupters (GFCIs) on all 125-volt, single-phase, 15-, 20-, and 30-ampere receptacles that are not part of the permanent wiring of a building or structure.
2. If a permanently wired receptacle (not equipped with GFCI protection) is used for temporary power in a construction project, GFCI protection must be provided at the user end.
3. Portable plug-in and cord-type GFCIs are probably the most practical devices for construction workers who use cord sets for temporary power when there is no protection at the source.
4. GFCIs sense imbalances or differences along the electrical circuit and shut it down when needed. For this reason, GFCI can be critical to workers in wet environments. The rule for GFCI does not exempt work with intrinsically safe or double insulated tools.
5. GFCIs must either be built into the overall circuit, as part of the outlet receptacle, or using protected cord sets or GFCI devices.

6. GFCI protection can be anywhere on the circuit as long as it works effectively to protect the worker. Protection can be for the entire circuit, the outlet receptacle, or the extension cord.
7. For receptacles with more than 125 volts, single-phase, or more than 30-amp capacity, use GFCI or have a program that ensure equipment is grounded: see OAR 437-003-0404(3).
8. There must be a written description of assured equipment and grounding program at each job site that includes specific procedures.
9. One or more competent persons should be designated to run the program. (A competent person is someone who is capable of identifying hazards and has authority to promptly correct them).
10. Each day, inspect all extension cords and equipment (plug connected) for external defects before using them.
11. Conduct periodic tests of all grounding conductors for continuity and test each receptacle or plug to ensure that the grounding conductor is connected to the right terminal.
12. Testing is required before the first use, before the first use after a repair, before use after any event that could cause damage, and at least every three months (six months for fixed cords sets and receptacles not exposed to damage).
13. Record all tests by identifying each cord, receptacle, or piece of equipment and its test date or test interval. Keep the test record until a new record replaces it using logs, color coding, or other means. These records must be available on the job site.
14. All electrical receptacles located within 6 feet of a water source (i.e. sink) must have a GFCI on the receptacle or the circuit that controls that receptacle.

BURIED ELECTRICAL LINES

1. Any time workers are required to start any in-ground work like digging or driving objects, OR-OSHA standard OAR 437-003-1926.651(b)(1) requires locating utilities before digging. For more information see: <http://osha.oregon.gov/OSHAPubs/hazard/2993-05.pdf>
2. The primary contractor or facilitator of the work must call the Oregon Utility Notification Center (OUNC) before starting work. Call (800) 332-2344.
3. OUNC will then come out to locate and mark all utilities in the area where the work will be performed.
4. The contractor or facilitator of the work must ensure that power to any electrical lines in the area of work must be deenergized to ensure employee safety.
5. If a worker contacts an underground line or pipe, the contact could be fatal.
6. In addition, the contractor or person responsible for the work is responsible for all repair costs if they did not contact OUNC before starting work.

OVERHEAD ELECTRICAL LINES

1. To protect those working near overhead power lines from accidental contact, the Oregon Legislature passed into law the High Voltage Overhead Line Safety Act. See ORS 757.800 and 757.805.
2. The law provides that no work activities take place within 10 feet of a high voltage overhead power lines until the following two requirements are met:
 - a. The responsible party must notify the utility operating the line of the intended work activity.
 - b. The responsible party and the utility must complete mutually satisfactory precautions for the activity.
3. As soon as you inform your local utility of your intended work activity, the following can occur:
 - a. Coordination of work schedules.
 - b. Identification of temporary mechanical barriers to prevent contact with the lines.
 - c. Temporary de-energizing and grounding of the lines
 - d. Temporary raising or moving of the lines.

PERSONAL PROTECTIVE EQUIPMENT

1. Employees must wear appropriate Personal Protective Equipment (PPE) when working around electrical sources. See PPE standard at General Industry Div. 2 Subdivision I: 1910.137 Electrical Protective Equipment. Electrical protective equipment is subject to regular electrical tests to ensure they are still providing protection to the employee.
2. Electrical protective equipment will be maintained in a safe, reliable condition.
3. Insulating equipment will be inspected for damage before each day's use and immediately following any incident that can reasonably be suspected of having caused damage. Insulating gloves will be given an air test, along with the inspection.
4. Insulating equipment will be stored in such a location and in such a manner as to protect it from light, temperature extremes, excessive humidity, ozone, and other injurious substances and conditions.
5. Insulating equipment with any of the following defects may not be used:
 - a. A hole, tear, puncture, or cut;
 - b. Ozone cutting or ozone checking (the cutting action produced by ozone on rubber under mechanical stress into a series of interlacing cracks);
 - c. An embedded foreign object
 - d. Any of the following texture changes: swelling, softening, hardening, or becoming sticky or inelastic;
 - e. Any other defect that damages the insulating properties.