



BOISE STATE UNIVERSITY

ENVIRONMENTAL HEALTH, SAFETY
AND SUSTAINABILITY

Electrical Safety


[Idaho Division of Building Safety](#)

General Health and Safety Standards 150

[OSHA 1910.1030](#)

Revision, July 15, 2015

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A. OBJECTIVES

- To provide principles and mandatory requirements for establishing, sustaining, and improving the systems, practices and procedures used to manage Boise State personnel exposure to electrical hazards.
- To ensure compliance with the following requirements:
 - Personnel receive training in and are competent in recognizing and managing electrical hazards and are competent in the use of electrical safety systems and procedures.
 - Work involving electrical hazards is done only by qualified personnel who are competent and authorized to do the work.
- To ensure that recognized hazards are addressed in job plans and procedures.
 - To manage the qualification, competence, and authorization of personnel working on or near the equipment within the shock and arc flash hazard boundaries.

B. DEFINITION OF TERMS

Authorized Persons for Electrical Lockout Tagout – The “authorized” persons shall be trained in and familiar with lockout tagout requirements for equipment they are responsible for completing maintenance on or minor adjustments.

Contractors Individuals hired by Boise State University or other 3rd party groups, specifically chartered to complete electrical work on campus. Boise State requires that all contractors abide by guidelines outlined in this program and our Lockout Tagout program on campus.

Electrically Safe Work Condition A state in which the conductor or circuit part to be worked on or near has been disconnected from energized parts, locked/tagged in accordance with established standards, tested to ensure the absence of voltage, and grounded if determined necessary.

Electronic Technicians – These individuals are authorized to conduct LOTO and use a volt meter in limited applications on low voltage equipment.

Exposed (as applied to live parts) Capable of being inadvertently touched or approached nearer than a safe distance by a person. It is applied to parts that are not suitably guarded, isolated, or insulated.


Limited Approach Boundary

- An approach limit at a distance from an exposed live part within which a shock hazard exists.

Other Individuals – These individuals are those that may be affected by someone completing a maintenance lockout but are not the individuals placing locks or conducting maintenance.

Prohibited Approach Boundary

- An approach limit at a distance from an exposed live part within which work is considered the same as making contact with the live part.

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Qualified Persons A qualified person shall be trained and knowledgeable of the construction and operation of equipment or a specific work method, and be trained to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.

- (a) Such persons shall also be familiar with the proper use of special precautionary techniques, personal protective equipment, including arc-flash, insulating and shielding materials, and insulated tools and test equipment. A person can be considered qualified with respect to certain equipment and methods but still are unqualified for others.
- (b) An employee, who is undergoing on-the-job training and who, in the course of training, has demonstrated an ability to perform duties safely at his or her level of training and who is under the direct supervision of a qualified person shall be considered to be qualified for the performance of those duties.
- (c) Such persons permitted to work within the Limited Approach Boundary of exposed live parts operating at 50volts or more shall, at a minimum, be additionally trained in all of the following:
 - (a) The skills and techniques necessary to distinguish exposed energized parts from other parts of electrical equipment.
 - (b) The skills and techniques necessary to determine the nominal voltage of exposed live parts.
 - (c) The approach distances specified in Table 130.2(C) from the NFPA 70E handbook and the corresponding voltages to which the qualified person will be exposed.
 - (d) The decision-making process necessary to determine the degree and extent of the hazard and the personal protective equipment and job planning necessary to perform the task safely.

Restricted Approach Boundary

- An approach limit at a distance from an exposed live part within which there is an increased risk of shock, due to electrical arc over combined with inadvertent movement, for personnel working in close proximity to the live part.
- Under no circumstance shall an unqualified person be permitted to cross the restricted approach boundary.

C. APPROACH DISTANCES

Limited Approach Distances:


System Voltage	Movable Conductor	Fixed Circuit Parts	Distance
50 - 750		X	3 ft. 6 in.
50 - 750	X		10 ft.
751 – 15k	X		10 ft.
751 – 15k		X	5 ft.

Prohibited Approach Distances:

System Voltage	Distance
50 – 300	Avoid Contact
301 - 750	1 in.
751 – 15k	7 in.


Restricted Approach Distances

System Voltage	Distance
50 – 300	Avoid Contact
301 - 750	1 ft.
751 – 15k	2 ft. 2 in.

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D. REQUIREMENTS

- **Justification for Work** Live parts to which an employee might be exposed shall be put in an electrically safe work condition before an employee works on or near them, unless the **EMPLOYER** can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations. (Any work done on a live energized part over 50V would require a licensed electrician use of the energized electrical work permit.)
- **Energized Electrical Work Permit** If live parts are not placed in an electrically safe work condition (i.e., for the reasons of increased or additional hazards or infeasibility per NFPA 70E 2004 130.1), work to be performed shall be considered energized electrical work and shall be performed by **PERMIT ONLY**.
- **Exemptions to Work Permit** Work performed on or near live parts by **Qualified** persons related to tasks such as testing, troubleshooting, voltage measuring, etc., shall be permitted to be performed without an energized electrical work permit, provided appropriate safe work practices and personal protective equipment are provided and used.
- Minimizing personnel exposure to electrical hazards shall be addressed through process and equipment design and specifications, installation details, maintenance, and the operation of electrical equipment and systems.
- Exposed electrical equipment operating above 50 volts shall be suitably guarded to prevent contact with personnel.
- Labels and equipment identifications shall be specified, designed, provided, and maintained to communicate warnings, cautions, and circuit information critical to the safe operation and maintenance of electrical equipment and systems.
- Electrical documentation necessary to identify and isolate electrical hazards shall be accurate, up-to-date, and readily accessible.
- Appropriate PPE shall be provided, maintained, and used.
- Voltage level, type of equipment and the task to be performed, in accordance with NFPA 70E 2004 tables 130.7(C)(9)(a) and 130.7(C)(10), shall determine the proper PPE for arc flash and shock hazard protection.
- Personnel within the flash protection boundary shall wear appropriate PPE.
- All PPE must meet appropriate standards (ANSI, ASTM).
- Prohibited Approach Boundary work will only be completed by individuals who are both qualified and trained in performing the task and recognizing the hazards involved.
- Safety signs, safety symbols, or accident prevention tags shall be used where necessary to warn employees about electrical hazards that might endanger them.
- Barricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas containing live parts. Conductive barricades shall not be used where it might cause an electrical hazard. Barricades shall be placed no closer than the Limited Approach Boundary given in Table 130.2(C).
- An attendant shall be stationed to warn and protect employees if signs and barricades do not provide sufficient warning and protection from electrical hazards.

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- Insulated floors, mats or platforms shall be provided for personnel handling exposed energized switches or fuses for voltages over 150 volts.
- Doors into electrical control panel rooms must be labeled Electrical Room.
- Jewelry is conductive, and rings should not be worn when completing electrical work.
- Flexible power cords shall not be permitted to run through holes in walls, ceilings, floors or to be attached to the facility building or structural surfaces. Flexible power cords should not be considered “temporary wiring”.
- Power strips need to be plugged directly into outlets.
- Power strips and flexible power cords shall not be daisy chained.
- No cord should ever be stapled to a surface.
- All general access electrical panels will remain secure.

E. Personal Protective Equipment (PPE)

General Information

- (a) Employees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.
- (b) When an employee is working within the Flash Protection Boundary he/she shall wear protective clothing and other personal protective equipment in accordance with NFPA 70E 2004 130.3
- (c) When working on energized equipment, the use of insulated blankets and tools is required. A work plan must always be developed prior to engaging in electrical work of this nature.

Care of Equipment Protective equipment shall be maintained in a safe, reliable condition. The protective equipment shall be visually inspected before each use.

- All PPE must be stored in a manner to prevent damage from cuts, tears, or chemical damage.
- Protective items that become contaminated with grease, oil, or flammable liquids or combustible materials shall not be used.



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Protective Clothing and Equipment	Hazard / Risk Category			
	-1	0	1	2
100% Natural fiber				
a. Shirt (long sleeve) provided by Boise State		X (2) (3)		
b. Pants (long) (Note 1)		X	X (1)	X
c. Jacket			X	X
Head Protection				
a. Hard hat	AN		X	X
Eye Protection				
a. Safety Glasses	AN	AN	X	X
Face and head area protection				
a. Arc-rated face shield			X	X
Hand Protection				
a. Leather Gloves (note2)			AN	AN
Foot Protection				
a. Leather work shoes		AN	X	X


Legend:

- AN As Needed PPE, appropriate for area
- X Required

Notes:

1. Regular weight, untreated, denim cotton blue jeans are acceptable
2. This is beyond NFPA 70E, it is Boise State University required
 It is a NFPA 70E requirement to wear rubber insulating gloves for all category 1 work except removal of bolted covers and performing infrared thermography and other non-contact inspections outside the restricted boundary, this is required for all voltages at Boise State except < 50 volts. Category 2 requires gloves to be worn for work on energized electrical conductors and circuit parts, including voltage testing and work on energized electrical conductors and circuit parts of utilization equipment fed directly by a branch circuit of the panel board or switchboard. For our facility class 2 work would fall into the >240V and up to 600V which may include voltage testing.
3. Disconnects are class 0 or higher at Boise State University

All Switches will be labeled with Switch or -1 Designation

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Hand and Arm Protection Employees shall wear rubber insulating gloves where there is danger of hand and arm injury from electric shock due to contact with live parts as required by NFPA 70E 2004 tables 130.7(C)(9)(a) and 130.7(C)(10).

- Clean dry leather gloves used for flash protection must be long enough to not allow any exposed flesh on the hands, wrists, or arms.
- Voltage rated gloves of the proper class for the voltage levels to be encountered. All gloves will be issued by the University. They will be di-electrically tested every 6 months.
- If voltage-rated gloves are required, the leather protectors worn external to the gloves satisfy the arc flash protection requirement.
- For high voltage work the appropriate high voltage protective gloves must be worn.

Head, Face, Neck, Ear and Chin Protection Employees shall wear nonconductive head protection wherever there is a danger of head injury from electric shock or burns due to contact with live parts or from flying objects resulting from electrical explosion. Employees shall wear nonconductive protective equipment for the face, neck, and chin whenever there is a danger of injury from exposure to electric arcs or flashes or from flying objects resulting from electrical explosion as required by NFPA 70E 2004 tables 130.7(C)(9)(a) and 130.7(C)(10).

- Nonconductive hard hat
- Polycarbonate arc-rated face shield (optional for LOTO applications)
- Foam earplugs with a noise cancelling muff

Eye Protection Employees shall wear protective equipment for the eyes whenever there is danger of injury from electric arcs, flashes, or from flying objects resulting from an electrical explosion as required by NFPA 70E 2004 tables 130.7(C)(9)(a) and 130.7(C)(10).

- Polycarbonate arc-rated face shield
- Safety glasses

F. Work Assignments

The following table outlines what tasks individuals may complete on campus in regards to electrical work.

Tasks	Electrician/ *Apprentice	HVAC Tech/ *Apprentice	Maint Craftsman	Irrigation Technician	Fire Alarm Technician	Building Facility Specialist	OIT	Custodial Services
Electrical Checklist (3yr)	X							
Installation of New Lines	X							
Running Conduit and running wire	X				X			
Work on live electrical parts above 50 V	X							
Opening of panel doors and setting up arc flash boundary when equipment is live	X	X			X			
Wiring of equipment up to 480 volts when power is off	X	X						



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Tasks	Electrician/ *Apprentice	HVAC Tech/ *Apprentice	Maint Craftsman	Irrigation Technician	Fire Alarm Technician	Building Facility Specialist	OIT	Custodial Services
Completing work from the disconnect to the piece of equipment	X	X			X			
Troubleshooting/Diagnostic work while equipment is energized	X	X	X		X			
*Resetting electrical breakers	X	X	X		X	X		
Changing ballasts with fixture de-energized	X	X	X		X	X		
Use of a voltage meter	X	X	X	X	X	X	X	
Work on live equipment up to 50 volts	X	X	X	X	X	X	X	
Reset breaker for specific equipment	X	X	X	X	X	X	X	
Changing light bulbs	X	X	X	X	X	X	X	X
LOTO for simple maintenance adjustments per Job Instruction	X	X	X	X	X	X	X	X
Assured grounding of all extension cords and portable electrical devices	X	X	X	X	X	X	X	X

- "other" trained individuals may reset breakers once site electricians have verified they can safely complete this task.

G. Emergency Situations

If individuals are having a problem with equipment turn off the power at the local disconnect. If this does not eliminate the problem contact FO&M or dispatch.

If the disconnect is on fire evacuate the room and call 911

If you observe someone being shocked, and it is safe for you to do so, turn off the power source and knock them away with a non-conducted tool. Use a piece of wood and only do this if you can safely accomplish the task. Immediately contact 911.

H. Training and Evaluation

All qualified electrical workers shall be trained on the following


- CPR and basic first aid including treatment of electrical shock and treatment of burns.
- Proper use of PPE
- Use of a voltage meter
- NFPA 70E standard

Training on the electrical program and LOTO is required annually

New or transferred Employees will be trained including a 30 day review.

I. Documentation and Procedures

This program will be reviewed annually.

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The facility will maintain good electrical drawings of all circuitry and equipment in the buildings in concert with A&E Services.

For arc flash review all single line drawings will need to be revised and sent off for evaluation by Boise State's electrical department and A&E Services will receive copies of these updates.

Use of the Electrical Safety Assessment Checklist – this will be required every 3 years. The checklist is attached. If deficiencies are found they will be assessed and addressed immediately. Records will be filed with the electrical maintenance office.

J. How to “Qualify” individuals

Work Experience

Basic understanding of electrical principles

Basic wiring proficiency

Electrical safety

NFPA 70E

Proficient with electrical instruments per position

An Internal assessment process would include:


*Interview Employees interested in becoming “qualified” by the current qualified team

*Test the electrical knowledge of the individual

Conduct the following electrical tasks with review by the qualified team

*Wiring a box using a schematic

*Complete a 6 month “mentoring” program with the qualified team to prove proficiency.

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K. Task Requirements

For specific task and PPE requirements see appendices

- A – Panel Boards 240V and less
- B – Panel Boards 240V and higher
- C – MCCs
- D – Miscellaneous 600V class equipment
- E – Above 600V

L. Electrical Panel Working Clearances

Code does not require marking of the floor around electrical panels. However, Boise State will require that all floors will be marked in front of electrical service panels.

Condition 1 Code Requirements

0-600V 36" clearance from the panel and 30" wide or the width of the panel, whichever is greater.

Condition 2 Code Requirements and any metal object in front of the panel

0-150V 36" clearance from the panel and 30" wide or the width of the panel, whichever is greater.

151-600V 42" clearance from the panel and 30" wide or the width of the panel, whichever is greater.

M. Cord Testing Program “Assured Grounding”

All extension cords and portable electrical devices, ie. vacuums, buffers, power tools, are required to be visually inspected for condition prior to use. If cords are found to be defective they need to be tagged out immediately and returned to the maintenance shop for repair.

All installed tools, extension cords and portable electrical devices will be inspected for wear and tear and grounding on an annual basis. Each department will need to assign an Authorized individual to complete the task.

All cords should be inspected by the end of the first quarter of each year. All cords will need to be labeled per the following schedule.


2013 – White

2014– Green

2015 – Yellow

2016 Blue

2017 Orange

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Panel Boards – Voltages 240V and below

Task – assumes equipment is energized and work is performed within the flash boundary.	Hazard / Risk Category	V-rated Gloves Required?	V-rated Tools Required?
Operating a Circuit Breaker (CB) or fused switch with the COVERS ON.	0	N	N
Operating a CB or fused switch with the COVERS OFF	1	Y	Y
Any work performed on energized parts, including voltage testing.	1	Y	Y
Removal or installation of CBs or fused switches	1	Y	Y
Removal of bolted covers (to expose bare, energized parts)	1	Y	Y
Opening hinged covers (to expose bare, energized parts)	1	Y	Y

Panelboards – Voltages greater than 240V up to 600V (with molded case or insulated case circuit breakers)

Task – assumes equipment is energized and work is performed within the flash boundary.	Hazard / Risk Category	V-rated Gloves Required?	V-rated Tools Required?
Operating a Circuit Breaker (CB) or fused switch with the COVERS ON.	0	N	N
Operating a CB or fused switch with the COVERS OFF	1	Y	Y
Any work performed on energized parts, including voltage testing.	1	Y	Y



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ENERGIZED ELECTRICAL WORK PERMIT

PART I: TO BE COMPLETED BY THE REQUESTER

Job/Work Order # _____

1. Description of circuit/equipment/job location _____

2. Description of work to be done _____

3. Justification of why the circuit/equipment cannot be de-energized or the work deferred until the next scheduled outage:

Requester/Title

Date

Part II: TO BE COMPLETED BY THE ELECTRICALLY QUALIFIED PERSONS DOING THE WORK

Check when
Complete

1. Detailed job description procedure to be used in performing the above detailed work: _____
2. Description of the Safe Work Practices to be employed _____
3. Results of the Shock Hazard Analysis: _____
4. Determination of Shock Protection Boundaries: _____
5. Results of Flash Hazard Analysis: _____
6. Determination of Flash Protection Boundary: _____
7. Necessary personal protective equipment to safely perform the assigned task: _____
8. Means employed to restrict the access of unqualified persons from the work area: _____
9. Evidence of completion of a Job Briefing including discussion of any job related hazards _____
10. Do you agree the above described work can be done safely? __Y __N (If NO, return to requestor)

Electrically Qualified Person(s)

Date

Electrically Qualified Person(s)

Date

PART III: APPROVAL(S) TO PERFORM THE WORK WHILE ELECTRICALLY ENERGIZED:

Safety Manager

Maintenance/Engineering Manager

Electrical Knowledgeable Person



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The facility will have an Electrical Safety Assessment inspection performed every three years by a licensed electrician or a qualified electrical engineer. The following checklist will be used and completed during the inspection and given to the facilities maintenance manager the completion of the inspection. Items from the checklist that need repaired will be assigned to be repaired or brought up to standard by the qualified electrical worker for the area where the item is located.

Electrical Safety Assessment Checklist

*Please note that this document is intended to provide an initial snapshot of a site's electrical safety activities.
 It is not intended to be an all-inclusive checklist for compliance with Electrical Regulations.*

		Y	N	N/A	Comments
	<u>Equipment</u>				
1.	Is the manufacturer's data plate on equipment? 1910.303(e)				
2.	Are all electrical disconnects and circuit breakers labeled to indicate; Voltage (as necessary) and, Equipment controlled (required). E.g. 480 volts, Motor No. 1. 1910.303(e & f)				
3.	Is non-portable electrical equipment permanently wired with wires in conduit? (Exception: equipment that moves more frequently than 30 to 60 days and requires flexible wiring)? 1910.305(a)(1) 1910.308(a)(1)				
4.	Is all portable electrical equipment with power cords and plugs in good repair? 1910.334(a)(2)(ii)				



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		Y	N	N/A	Comments
5.	Are there any broken conduit, missing conduit junction box caps or covers, conduit pulled away from junctions, etc.? 1910.303(b)(1)				
6.	Are all ground conductors color-coded according to the National Electric Code? (CSA in Canada) 1910.305(f)				



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		Y	N	N/A	Comments
7.	Are all electrical wires in conduit if they pass through walls, floor openings, or within walls and floors? 1910.305(a)(4)(iv)				
8.	Temporary wiring. Are flexible cords and wiring protected from: Sharp corners & projections, and Where passing through doorways and other pinch points. Note: Passing temporary wiring through doorways is discouraged. 1910.305(a)(2)(iii)(G) .				
9.	Are electrical cabinets and panels kept closed and secured with all of the supplied fasteners? 1910.303(g)(2)(i)				
10.	Are doors to electric rooms, and motor control centers containing exposed live parts or conductors kept locked and open outward with panic hardware? (Unless under the observation of a qualified person at all times) 1910.303(h)(2)				
11.	Are there any exposed electrical wires or access points to conductors? (E.g. open knockouts, missing breakers, etc.)				



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		Y	N	N/A	Comments
12.	Are barricades and safety signs used to prevent or limit employee access to work areas with un-insulated energized electrical equipment? <u>1910.335(b)(2)</u>				
13.	Does the site have an assured grounding program for extension cords? NEC 527.6(b)(2), and NFPA 70E, 2-2.4.2.2.2				
14.	Are doors to electrical rooms containing live parts that are not enclosed within grounded, metal-enclosed equipment - labeled to indicate "access only by authorized persons"? <u>1910.303(g)(2)(iii)</u> and <u>1910.269(u)(4)</u>				
15.	Is correct Personal Protective Equipment (PPE) being used when working on energized equipment/circuit parts? <u>1910.335(a)(2)(ii)</u> NFPA 70E, Table 3-3.9.2.				
16.	Is work on energized electrical parts conducted only after confirming that de-energizing: a) Creates additional hazards, or b) Is in feasible due to equipment design or operational limitations. <u>1910.333(a)(1)</u>				



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		Y	N	N/A	Comments
17.	Are insulated tools or handling equipment (rated for voltage) used when working on energized equipment or parts? 1910.335(a)(2)(i)				
18.	When circuit breakers trip, are safety checks conducted to determine what caused the trip, prior to manually re-energizing the equipment? 1910.334(b)(2)				
19.	Are minimum working clearances maintained to permit safe operation and maintenance of electrical equipment with exposed energized parts? See tables (attached): S-1, 1910.303(g)(1)(i) , S-2, 1910.303(h)(3)(i) and S-3, 1910.303(h)(3)(iii)				
20.	Are electrical panel working clearances maintained? Marking of the floor in front of the service panel? Condition (1) 0-600 V 36" clearance from the panel and 30" wide or the width of the panel. Condition (2) 0-150-V 36" clearance from the panel and 30" wide or the width of the panel, whichever is greater. 151-600V 42" clearance from the panel and 30: wide or the width of the panel, whichever is greater.				
21.	Is the location of all underground electrical power lines and cables determined before digging, drilling or other similar work? 1926.416(a)(3)				



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		Y	N	N/A	Comments
22.	Are employees prohibited from working alone when performing specific tasks on energized lines or equipment over 600 volts? Example: Installation, removal or repair of equipment that exposes the employee to contact with energized parts. 1910.269(l)(1)(i)				
23.	Are employees who are exposed to the hazards of electric arcs, prohibited from wearing clothing made from the following types of material; Acetate, Rayon, nylon, Polyester? 1910.269(l)(6)(iii)				
	Training:				
24.	<u>Are qualified individuals identified and trained as required by:</u> 1910.269(a)(2)(ii) 1910.331 , 1910.332 , 1910.333 , 1910.334 , 1910.335 , and NFPA 70E, 2000 edition.				
25.	Are authorized individuals identified and trained as required by: 1910.269(a)(2)(i)				