



WESTERN CONNECTICUT STATE UNIVERSITY

ELECTRICAL SAFETY

PROCEDURE [S-109](#)

Draft Issued 12/10/97
Revised 2/98, 7/09, 10/14

Please direct any questions or comments about the applicability of this document to
Pano Koukopoulos, Director of Environmental Health and Safety

1.0 INTRODUCTION

2.0 DEFINITIONS

Acceptable

An installation or equipment is acceptable if it is accepted, certified, listed, labeled, or otherwise determined to be safe by a nationally recognized testing laboratory, such as Underwriters Laboratories (UL) and National Electrical Manufacturers Association (NEMA), or other local authority responsible for reinforcing occupational safety provisions of the National Electrical Code and found in compliance with the provisions of the National Electrical Code.

Wet Location

Installations underground or in concrete slabs or masonry in direct contact with the earth and locations subject to saturation with water or other liquids, such as vehicle washing areas and locations exposed to weather and unprotected areas.

Damp Location

Partially protected locations under canopies, marquees, roofed open porches and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, barns and cold storage warehouses.

Qualified Person

One familiar with the construction and operation of the equipment and the hazards involved. Whether an employee is considered qualified will depend upon various circumstances in the work place. It is possible and, in fact, likely for an individual to be considered qualified with regard to certain equipment in the work place, but unqualified for another. An employee who is undergoing on-the-job training and who, in the course of such training, has demonstrated an ability to perform duties safely at his or her level of training is considered under the direct supervision of a qualified person is considered to be qualified.

3.0 GENERAL REQUIREMENTS

- a. The equipment user must inspect all equipment prior to and after use.
- b. Electrical equipment must be free from recognized hazards.
- c. Splices must be strong, safe, insulated and connected by mechanical means or welded.
- d. Electrical equipment marked with manufacturer's identity, voltage, current or other ratings as necessary.
- e. Each disconnect shall be marked to indicate its purpose unless obvious.
- f. Work clearances of at least 3 feet shall be maintained in front of equipment (<600V).
- g. Live parts shall be guarded (approved cabinets) or accessed by only those qualified persons (those permitted to work on or near exposed live parts).

4.0 WIRING AND DESIGN PROTECTION

- a. No grounded conductor may be attached to any terminal or lead so as to reverse designated polarity.
- b. Construction work equipment shall be protected by a GFCI or assured equipment grounding program.

5.0 WIRING METHODS, COMPONENTS, AND EQUIPMENT FOR GENERAL USE

- a. Temporary wiring used for remodeling, maintenance, repair, experimental work or decorations shall not exceed 90 days.
- b. Lamps shall be protected from breakage by fixtures or elevations of at least 7 feet.
- c. Unused openings in cabinets, boxes, and fittings shall be effectively closed.
- d. All conductors entering boxes and cabinets shall be protected from abrasion.
- e. Flexible cords shall not be run through holes in walls, floors, ceilings, doors, or windows and shall not be concealed.
- f. Flexible cords shall be connected so that strain relief is provided which will prevent pull from being directly transmitted to terminal screws or joints.
- g. Hand lamps shall have a molded composition handle and bulb guard.
- h. Approved equipment and wiring shall be used in hazardous locations.

6.0 SELECTION AND USE OF WORK PRACTICES

- a. Energized parts shall be de-energized before the employee works on or near them. Lockout / Tagout (LOTO) procedures shall be followed. Qualified individuals must verify de-energization. De-energization must take place unless the employer can demonstrate that the de-energizing introduces additional or increased hazards or is not feasible due to the equipment design or operational limitations. Only qualified individuals can work on energized parts. NOTE: Live parts that operate at less than 50 volts to ground need not be de-energized if there will be no increased exposure to electrical burns or to explosion due to electric arcs. Increased hazards include interruption of life support equipment, deactivation of emergency alarm systems, shutdown of hazardous location ventilation equipment or removal of illumination from the area, work that may be performed on or near energized circuit parts because of unfeasibility due to equipment design or operational limitations include testing of electric circuits that can only be performed with the circuit energized, work on circuits that forms an integral part of a continuous industrial process in a chemical plant that would otherwise need to be completely shut down in order to permit work on one circuit or piece of equipment.
- b. If exposed live parts are not de-energized, work practices shall protect employees against contact with energized circuit parts directly with any part of their body or indirectly through some other conductive object.
- c. Overhead lines shall be de-energized and grounded prior to working near or on them or other protective measures must be taken (insulators).
- d. Unqualified individuals working near overhead lines shall not come closer than:

<u>Feet</u>	<u>Voltage</u>
10 feet	50kv
10 feet plus 4 inches for every 10kv over 50kv >50kv	
- e. Qualified individuals working in the vicinity of overhead lines may not approach or take any conductive object without an approved insulating handle closer to exposed energized parts than in Table S-5 of 1910.333.
- f. Qualified persons working in the vicinity of overhead lines shall be insulated with appropriate rated gloves and sleeves.
- g. Vehicular and mechanical equipment shall maintain 10-foot clearance minimum plus 4 inches for every 10kv over 50kv for overhead power lines.

- h. Vehicles in transit must maintain 4 feet plus 4 inches for every 10kv over 50kv from overhead lines.
- i. Portable ladders with non-conductive side rails shall be used when they could contact exposed energized parts.
- j. Conductive articles of jewelry and clothing such as watches, rings, etc., shall not be worn if they might contact energized parts.
- k. Only qualified people can defeat electrical interlocks on a temporary basis while they work on equipment.

7.0 USE OF EQUIPMENT

Portable electric equipment such as cord-and-plug connected equipment, including flexible cord sets (extension cords):

- a. Shall be handled in a manner to avoid damage.
- b. Shall not be used to raise or lower equipment.
- c. Shall not be fastened with staples or hung so as to outer jacket or insulation.
- d. Shall be visually inspected before each use and not used until rendered safe if any of the following conditions exist:
 - 1. Loose parts
 - 2. Deformed or missing pins
 - 3. Damage to outer jacket or insulation
 - 4. Indications of internal damage, such as pinched or crushed outer jacket, cracks in casing, discolored casing (which could indicate overheating)
- e. Plugs and receptacles shall mate properly.
- f. Flexible cord that is used with grounding type equipment shall contain an equipment grounding conductor.
- g. Ground connections shall never be altered.
- h. Approved equipment shall be used in wet / damp locations.
- i. Hands must not be wet when plugging and unplugging flexible cord and plus connected equipment if energized equipment is involved.
- j. Energized plug and receptacle connections shall be handled only with insulating protective equipment if the condition of the connection could provide a conducting path to the employee's hand (wet cord).
- k. Locking type connectors shall be properly secured after connection.

Electric Power and Lighting Circuits

- a. Only load rated switches, circuit breakers specifically designed for disconnecting means shall be used for opening, closing or reversing of circuits under load. Cable connectors, not of the load break type, fuses, terminal lugs and cable splice connections may not be used for such purposes, except in an emergency.
- b. Circuits shall not manually be re-energized until determined that it is safe to do so.
- c. Only qualified persons have the authority to access electrical closets and electrical distribution panels.
- d. Only qualified persons shall reset tripped circuit breakers.

Test Instruments and Equipment

- a. Only qualified persons may perform testing work on electric circuits or equipment.

- b. Individuals shall visually inspect all test instruments and equipment and all associated power cords, probes, and connectors prior to use.
- c. Test interments shall be rated for the circuits.
- d. Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent such hazardous conditions from developing.

8.0 USE OF EQUIPMENT INCLUDING PERSONAL PROTECTIVE EQUIPMENT

- a. Personal protective equipment (PPE) shall be worn when there is potential for electrical hazards and shall be appropriate for the parts of the body that need to be protected.
- b. All equipment, including PPE shall be maintained in a safe and reliable condition.
- c. See Personal Protective Equipment Program for hazard assessments.

8.1 GENERAL PROTECTIVE EQUIPMENT AND TOOLS

- a. When working near exposed energized conductors or circuit parts, only approved insulated tools or handling equipment shall be used.
- b. Fuse-handling equipment insulated for the circuit voltage shall be used to remove or install fuses when the fuse terminals are energized.
- c. Ropes and handlines used near exposed energized parts shall be non-conductive.
- d. Protective shields, barriers or insulating materials shall be used to protect employees working near exposed energized parts.

9.0 ALERTING TECHNIQUES

- a. Safety signs and tags shall be used when necessary to warn employees about electrical hazards.
- b. Barricades shall be used in conjunction with safety signs. Conductive barricades may not be used where they might cause an electrical contact hazard.
- c. Attendants stationed to warn when signs and barricades are not sufficient.

10.0 TRAINING

All employees who face a risk of electric shock (50V or more) that is not reduced to a safe level by electrical installation shall receive annual training. This training requirements applies, but is not limited, to the following job classifications: electrical and electronic engineers, electrical and electronic assemblers, electrical and electronic technicians, electricians, industrial machine operators, material handling equipment operators, mechanics and repairers, painters, riggers and roustabouts, stationary engineers and welders.

11.0 RESPONSIBILITIES

The Interim Director of Environmental, Health and Safety shall:

- a. Ensure, through workplace inspections, that the requirements of this chapter are followed.
- b. Provide appropriate electrical safety tags, locks, or other warning devices as necessary in order to lockout and / or tagout electrical circuits or electrical equipment to conduct tests or repairs.
- c. During the annual workplace inspections, conduct visual inspections of electrical equipment for compliance with the standards of NFPA National Electrical Code. Discrepancies will be noted in the building inspection report.

- d. Affix a “Danger - Defective Equipment, Do Not Operate” tag (Appendix 5-D) on all defective equipment, prohibiting its use until repaired and electrical safety checked.

Department Heads shall:

- a. Ensure that all electrical equipment under their cognizance is inspected in accordance with this chapter.
- b. Ensure that only acceptable electrical equipment and appliances, as defined in this chapter, are used.
- c. Establish procedures for tagging out fixed and portable electrical equipment found to be defective.

Supervisors shall:

- a. Routinely inspect their work areas and electrical equipment for compliance with this chapter.
- b. Ensure that defective equipment is removed from service, danger tagged (Appendix 5-D) and reported to the Interim Director of Environmental, Health and Safety.

Workers shall:

- a. Visually inspect all electrical equipment before and after each use for any signs of defects or malfunctions.
- b. Tagout (Appendix 5-D) and turn in defective electrical equipment to his/her supervisor.

Appendix 5-A

GUIDELINES FOR INSPECTION OF EXTENSION CORDS

PROCEDURE

1. Inspect extension cords; measure circuit resistance to ground.
2. Extend extension cord cable; inspect sheath for cuts, tears, and abrasions. Ensure cable has no splices or exposed conductors.
3. Inspect extension cord plug and receptacle for loose, broken, and missing parts.
4. Inspect plug and receptacle insulation for cracks, chips, and signs of overheating.
5. Inspect plug and receptacle contacts for foreign matter, pitted and corroded surfaces.
6. Measure resistance between contacts; observe multimeter and simultaneously work cable with a twisting and bending motion to detect broken strands. Resistance must be more than one MEGOHM. If resistance is less than one MEGOHM, take the following steps:

Attach warning tag, placing unit “out of service” until repaired;
and notify responsible Department Head
7. Measure resistance between each corresponding plug and receptacle contact, simultaneously working the cable with a twisting motion to detect broken strands. If the resistance is greater than one OHM, take the following steps:

Attach danger tag (Appendix E), placing unit “out of service” until repaired;
and notify responsible Department Head
8. If inspection and resistance checks are satisfactory, return the cord to Maintenance for repair or disposal.

Appendix 5-B

VISUAL INSPECTION ONLY

GUIDELINES FOR INSPECTION OF DOUBLE INSULATED CASE-TYPE PORTABLE ELECTRICAL DEVICE INSULATION RESISTANCE

PROCEDURE

1. Inspect double insulated case-type portable electrical device.
2. Extend device power cable; inspect sheath for cuts, tears, and abrasions. Ensure cable has no splices or exposed conductors.
3. Inspect reinforcement sleeve for cuts and cracked surfaces; sleeve construction should be of non-conducting material.
4. Inspect case for cracked, loose, broken and missing parts, oil or foreign materials.
5. Inspect attachment plug for loose, broken and missing parts.
6. Inspect plug insulation for cracks, chips, and signs of overheating.
7. Inspect plug contact for foreign matter, pitted and corroded surfaces.

Appendix 5-C

VISUAL INSPECTION ONLY

GUIDELINES FOR INSPECTION OF DOUBLE INSULATED CASE-TYPE PORTABLE ELECTRICAL DEVICE INSULATION RESISTANCE

PROCEDURE

1. Inspect portable electrical device; measure circuit resistance to ground.
2. Extend device power cable, inspect sheath for cuts, tears, and abrasions. Ensure cable has no splices or exposed conductors.
3. Inspect reinforcement sleeve.
4. Inspect case for cracked, loose, broken and missing parts, oil or foreign materials.
5. Inspect filter assembly on hand held, dry-pick up vacuum cleaner / blowers to ensure they are intact and functional, if applicable.
6. Inspect attachment plug for loose, broken and missing parts.
7. Inspect plug insulation for cracks, chips, and overheating.
8. Inspect plug contacts for foreign matter, pitted and corroded surfaces.
9. Measure resistance between each exposed metal part of device and the ground connection with a multimeter; observe meter and simultaneously work cable with a twisting and bending motion to detect broken strands. Resistance must be less than one OHM. If resistance is one OHM or more, take the following steps:

Attach Danger Tag (Appendix 5-D), placing unit “out of service” until repaired; and notify responsible activity
10. Position device control switch to on position, if applicable. Measure resistance from each attachment plug line voltage contact to each exposed metal part of device, including metal reinforcements, if provided. Resistance must be one MEGOHM or more. If resistance is less than one MEGOHM, take the following steps:

Attached Danger Tag, placing unit “out of service” until repaired; and notify responsible activity
11. Position device control switch to off position, if applicable. If resistance is less than one OHM in Step 9, and more than one MEGOHM in Step 10, return equipment to normal use.