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**TITLE:** Electrical Safety for Construction**STANDARD:** 228**ISSUE DATE:** 31 October 2015**ISSUE No:** 001

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**Definitions (in relation to this Standard)**

Qualified Person	Shall be trained, knowledgeable, experienced in the construction and operation of equipment or a specific work method and be qualified to recognize and avoid the electrical hazards that might be present with respect to that equipment or work method.
Competent Person	Trained, experienced & qualified (Approved by Royal Commission after completing a competency test).
Voltage	The difference of potential between any two conductors in a circuit or between a conductor and ground. The level of electrical energy, measured in Volts that “pushes” current through the using device or person.
Current	The flow of electrical energy, measured in Amperes (Amps) or Milliampere (thousandths of an Amp) flowing through conductor to a device where it is transformed to mechanical or thermal energy. A very small amount of current \ through a person’s body can be fatal,
Resistance (and Impedance)	The characteristic of material or a machine that resists flow of current and in coordination with Voltage and Current allows the machine to create mechanical or thermal energy. A person’s lower body resistance, usually due to grounding and/or wet conditions can make him more subject to injury or death from electrical shock.
Ground Fault Circuit Interrupter (GFCI) for Personnel	An electrical device for personal protection that disconnects a circuit whenever it detects that the electric current is not balanced between the energized (hot) conductor and the neutral exceeds an established value, usually a very small value (6 milliamps). Such an imbalance is sometimes caused by current leakage through the body of a person who is grounded and accidentally touching the energized part of the circuit. A lethal shock can result from these conditions. GFCI's are designed to disconnect quickly enough to reduce the harm caused by such shocks although they are not intended to provide protection against overload or

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short-circuit conditions. A GFCI is also known as a Residual Current Device (RCD), Earth Leakage Circuit Breaker (ELCB) or an Appliance Leakage Current Interrupter (ALCI). The GFCI for Personnel is not to be confused with a GFCI for Equipment Protection. The senior qualified electrical person shall be consulted if there is any potential of confusion. GFCI / ELCB / RCD / ALCI being used in RC projects shall be of 30mA sensitivity or lower.

### Ground(ing); Ground(ed)

Intentionally or unintentionally connecting any object to the ground, directly or indirectly, as through a wet soil area or through any other object that is grounded; also known as "earthing"; "earthed". Grounding is a protective requirement for all metal objects on a site that may accidentally become energized. If an energized circuit comes in contact with the grounded soil or equipment, that creates a "ground fault" and a protective circuit breaker(s) should trip. If a person becomes a current-carrying part of the path (circuit) between the electrical source and ground, he is in danger of injury or death.

## Cross-References

- Attachment C General Conditions, Article 15 – Contractor's Personnel
- Standard 209 – Small Tools
- Standard 235 – Control of Hazardous Energy (Lockout/Tagout)

## Standard

*This Standard applies to all electrical cord sets and receptacles not part of the permanent electrical wiring system of a building or structure, and all electrical equipment and tools used in connection with construction activities.*

*All such equipment must comply with **either** the Assured Equipment Grounding Program, **or** the GFCI requirements as specified.*

1. Only qualified electricians may set-up, modify, inspect and repair electrical circuits. All electricians must keep a copy of their qualification on their person. All inspection and repair details are to be recorded and made available to Royal Commission upon request.
2. A Lock-out/Tag-out and permit-to-work system must be in place when changes are being made to electrical circuits and electrical wiring is not terminated (this includes the permanent electrical wiring system of an existing building). The permit and Lock-out/Tag-out system shall ensure that no circuit being worked upon can be accidentally or intentionally energized. (Refer to Standard 235, Control of Hazardous Energy (Lockout/Tagout)).
3. All live electrical panels must be physically 'locked-out'. The issuance of labeled keys to 'locked-out' electrical panels must be controlled & secured in a locked cabinet to minimize the risk of an accidental electrocution.

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4. Lock-out/Tag-out will be issued, controlled and closed by the senior electrician on site and a copy of the permit to work is to be prominently displayed at the electrical panel being worked upon.
5. All electricians are to be trained in the Contractor's permit to work and Lock-out/Tag-out procedures.
6. Permits-to-work must be kept for the entire length of the Project or revised when any event occurs that changes the conditions stated in the Permit-to-Work.
7. Unqualified, unauthorized persons shall not open any electrical enclosure or apparatus, nor shall they energize circuits without authority to do so.
8. Once the building or structure is energized, no exposed wires are permitted on 'live' circuits. All electrical wire circuit ends must have their 'end use' fitting applied (i.e. wall socket cover, light switches) and be screwed securely in place.
9. Employees will visually inspect receptacles (sockets), extension cables, cords and equipment connected by cord and plug before each day's use in order to determine if there are external defects. Where there is evidence of damage, the damaged item is to be taken out of service immediately, tagged with a defective tool tag and sent for repair.
10. No electrical tools must be used without a plug, and no extension cables may be used with damaged outlets or missing covers. All extension cables are to be of industrial standard and fit-for-purpose. All plugs and sockets must be compatible and allow the direct transfer of the ground connection.
11. In the event a coworker becomes overcome by an electrical circuit, a nearby person should not attempt to grab and pull him to safety, lest they also be overcome, the co-worker should immediately send for emergency services & the senior electrician so that the power source can be disconnected.
12. All site offices shall be equipped with SASO 2203 compliant sockets, all office electrical systems & sockets shall be grounded.
13. All fluorescent light fittings used on site or in the office area shall be provided with a protective cover.

### Assured Equipment Grounding Program

14. An electrical continuity and polarity test for all circuitry shall be performed by a qualified person on all cords, extension cables and receptacles that are used on site **and** a ground conductor continuity test shall be performed on all electrical equipments that are used on site as follows:
  - Before first use of the equipment
  - At intervals not to exceed 3 months
  - Before repaired equipment is returned to service
  - Before equipment is used after any incident that may have caused damage
15. All electrical equipment that is to be plugged into these cords, extension cables and receptacles must have a grounding line. All extension cords and cables are to be fully extended to ensure there is no risk of overheating.

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16. All tests will be made, recorded and retained by the senior electrician on site, which are to be made available to the Royal Commission on request
17. All equipments that undergo this test will be marked with electrician's tape and will conform to the following color coding following satisfactory completion of inspection:
  - red January – March inclusive
  - blue April – June inclusive
  - yellow July – September inclusive
  - green October – December inclusive
18. Any equipment not passing the continuity test will be taken out of service, tagged with a defective tool tag, and sent for repair
19. All repaired equipment must pass the continuity test before returning to service

### Ground Fault Circuit Interrupter (GFCI) and Assured Equipment Grounding Program Requirements

20. Where applicable codes and standards are not more stringent, GFCI's will be provided for all 120V and 110V, single phase, 15, 20 & 30 Amp receptacle outlets. Receptacles rated other than 120V/110V 15, 20 & 30 Amps that are not part of the permanent wiring of a building or structure, shall have either GFCI protection or the Assured Equipment Grounding Program implemented.
21. Where applicable GFCI's may also be required according to the national standards.
22. Where reasonable, GFCI's must be located as near as possible to the equipment being used, with short cords to the tools to reduce unsafe clutter. The use of specialized, construction site grade, temporary power distribution units with integral GFCI receptacles are encouraged.
23. GFCI's are to be inspected on a quarterly basis and color coded as per Serial 15 above. All tests will be made, recorded and retained by the senior electrician on site, which are to be made available to the Royal Commission on request. Functional check of the GFCI by pressing the trip button shall be made by the craftsman prior to powering equipment from a GFCI receptacle.

### Generators

24. All generators and transformers will be maintained in a good condition.
25. All generators shall have sufficient capacity for the application for which they are used. Rating calculations for all main site supply generators shall be performed by the senior electrician and records kept in his office.
26. Any rotating components will be guarded.
27. The area around generators shall be maintained free of fuel and oil spills.
28. Where applicable, external fuel tanks will be located in areas with containment provisions rated to 110% of the total tank contents as per Standard 400 - Management of Potentially Polluting Substances.

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- 29. All generators (including lighting towers, welding sets etc...) shall be directly connected to the ground system or separately grounding using a 1 meter copper ground rod which shall be firmly inserted at least 300mm into the sand.
- 30. Outlets will be in good condition with no exposed conductors.
- 31. Generators are to be shaded and protected from the elements. Silent type (enclosed) generators should be provided.
- 32. Adequate hazard warning signage is to be displayed (no smoking within 25m, hearing protection required etc...)
- 33. Generator locations are to be supplied with relevant fire extinguisher and hearing protection

### Distribution (temporary)

- 34. All distribution panels shall carry an international "electrical Hazard" warning sign consisting of a yellow triangle with a black lightning bolt, & the name and contact details of the senior electrician (and/or approved Competent Person)
- 35. All distribution panels shall be kept locked and the keys held by the senior electrician in a dedicated locked cabinet in his office.
- 36. Distribution boards shall have an RCD/GFCI fitted on the circuit breaker of all circuits that feed a wet area or a circuit which feeds power tools / electrical machinery / extension leads.
- 37. All distribution boards shall be weather-proofed and grounded & have a unique number. Wooden distribution boards can only be provided for indoor dry areas, all other outdoor and wet areas shall be provided with a metal distribution board.
- 38. All distribution boards shall be provided with a ground terminal strip for the termination of all ground wires, and a separate neutral terminal strip for the termination of all neutral wires. The ground and neutral systems shall not be interconnected at any point in the electrical distribution system.
- 39. Terminal points will be in an enclosure with feed and outlet cables channeled through the enclosure via rubber/plastic grommets to prevent insect infestation and water penetration.
- 40. Cables to and from distribution boards shall be clearly identified and labeled, the point at which the distribution board may be de-energized shall be clearly noted.
- 41. Temporary electrical power shall not be "tapped" off from any part of a permanent electrical wiring system of a building or structure.
- 42. All Cables shall have a unique number and shall be of a size and rating suitable for purpose, capacity & volt drop calculations for all cables shall be kept in the senior electricians' office.
- 43. Splicing of cables is not permitted; cables will be extended or repaired using the correct mechanical fittings, these joints shall then be weather proofed using a heat shrink or equivalent method. (See Appendix 1).

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44. Domestic standard cables and fittings shall not be allowed on site.
45. Particular attention shall be given to cable management to ensure that cables are routed in such a manner as to prevent an obstruction, cable damage (from vehicular traffic) or a trip hazard. The method of such routing shall be in a manner that does not damage or affect the integrity of the cable. Where cables are hung from the ceiling/walls insulated cable hangers must be used.
46. Precautions shall be taken to ensure that cables cannot come into direct contact with metal scaffolding.
47. All cables on site must be terminated at both ends; cables that are no longer in use should be disconnected and removed from site.
48. All circuit breakers shall be selected based on the loads to which they are connected, the senior electrician shall provide a calculation to confirm that all circuit breakers will operate correctly in the event of a fault occurring.
49. Load & volt drop checks shall be performed on the site systems by the senior electrician on a quarterly basis, and the results kept in his office.
50. The senior electrician must maintain an up to date single line diagram of the site electrical system in his office.

### Electrical Hand Tools

51. The only electrical hand tools that can be used on site are either 120/110V mains operated or battery operated. Where the mains electrical supply is higher than 120/110V, step-down isolation transformers must be used to reduce the supply to the hand tools to 120/110V.
52. In special circumstances where a 120/110V tool is not available in the market for the specific task, permission must first be sought from Royal Commission to use the tool, and then only higher voltage tools that are double insulated may be used.
53. Equipment casings will be intact with no loose fittings or exposed cables.
54. Plug & socket fittings shall be of an approved industrial type. (See Appendix 2).
55. Tools shall be subjective to preventative maintenance schedules as per Manufacturer's recommendations
56. Any electrical tool showing evidence of damage, overheating, worn or poorly repaired power cords, missing grounds or other abnormal condition shall be immediately removed from use, tagged and sent for repair.
57. Contractor must conduct scheduled inspections of all electrical hand tools, by a qualified electrician, using the color coded system as per Serial 15 above, to identify electrical tools as having been inspected and fit-for-use.

### Overhead Transmission / Power Lines

58. Where overhead power transmission lines exist on, or adjacent to, construction sites or access roads to the site, the Contractor shall identify in the Construction Phase ES&H

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Plan the methods to be used to prevent contact with the overhead lines by the following (applicable to the Project) activities:

- Lifting Operations (including HIAB's)
- Tipper Trucks
- Construction Plant (including concrete pumps)
- Man-Lifts (MEWPS)
- Scaffolding
- Ladders

59. As a general rule, an SEC Encroachment Permit must be obtained where works requires construction plant, vehicles or equipments to be closer than:

- |   |     |
|---|-----|
| ▪ Overhead lines suspended from steel towers in any direction | 20m |
| ▪ Overhead lines supported on wooden poles in any direction   | 12m |

However, SEC will specify clearances required for given voltages specific to the site when Encroachment Permit is initially sought.

60. All work to be carried out within the above limits shall be controlled by a Permit to Work System.

61. All workers, including delivery drivers, sub-contractors etc must receive specific toolbox talks detailing the hazards and control measures for working under, or adjacent to, live overhead power lines.

62. Risk assessments must be conducted by the Contractor to identify control measures to be used, such as goal posts (See Figure 1) or exclusion zones.

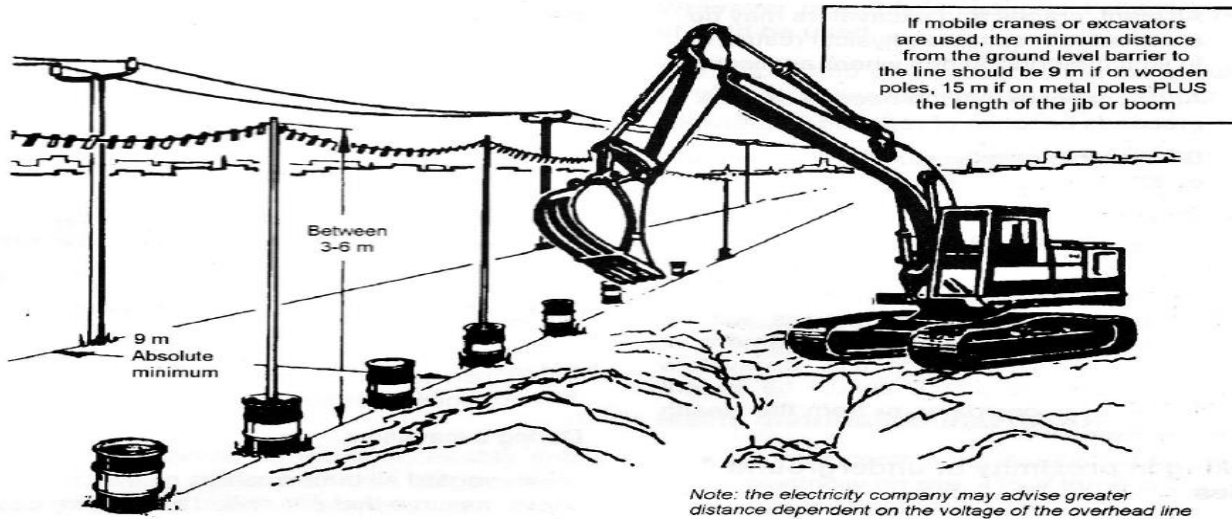


Figure 1 – “goalposts”

Barriers to prevent vehicles and construction plant contacting overhead power lines

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000	May-2009	Original	MS	WG	HS
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## CONNECTING TEMPORARY ELECTRICAL CABLES

### Introduction

Connecting temporary electrical cables on site is a common task but must be done properly to remove the risk of electrocution and ensure the safety of all workers. The connection must provide a good electrical connection and be mechanically strong to prevent the live cables becoming accidentally disconnected.

### **Control measures**

These images show the correct and unacceptable ways to connect temporary cabling.

**CORRECT**



**NOT ACCEPTABLE**





INDUSTRIAL TYPE PLUGS/SOCKETS



110V



230V



415V