

SAFETY AND HEALTH STANDARD ELECTRICAL GROUNDING

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and National Electrical Safety Code requirements.

- 16.10.3.2 **POWER LINES** - All structures, hardware, shield wires, and pole-mounted transformers shall be grounded.
- 16.10.3.3 **SUBSTATIONS** - All exposed metal parts of switches, structures, transformers, fences, gates, buildings, switchboards, breakers, meters, relays, lightning arresters, and communication equipment shall be grounded.
- o All substations shall have a ground grid to which all equipment is bonded. Resistance of grid to earth shall not exceed 25 ohms.
- 16.10.3.4 **FIXED EQUIPMENT** – Equipment that is fastened in place or connected by permanent wiring methods. Exposed non-current-carrying metal parts of fixed electrical equipment including motors, generators, frames, and rails of electrically operated cranes, electrically driven machinery, etc. shall be grounded.
- 16.10.3.5 **PORTABLE EQUIPMENT** – Equipment that is fed with portable cords or cables intended to be moved from one place to another. The non-current-carrying metal parts of portable and / or plug-connected equipment shall be grounded.
- o Portable electric-powered equipment such as conveyors, electric shovels, drills, etc. with associated portable substations, and switchgear shall be connected to a safety ground system. Trailing cables powering such equipment will have adequately sized ground conductors with continuously monitored ground continuity check equipment.
 - o Portable tools and appliances protected by UL approved system of double insulation, or its equivalent, need not be grounded. Where such an approved system is used, the equipment shall be distinctively marked.
 - o Extension cords used with portable electric tools and appliances shall be of three-wire type and shall be maintained in good condition.
- 16.10.3.6 **TEMPORARY WIRING** - All temporary wiring shall be effectively grounded in accordance with the National Electrical Code.
- 16.10.3.7 **TESTING** – Operators / craftsmen shall conduct the following tests. (See attached procedure and recordkeeping forms)

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REFERENCES:National Electric Code (NEC)National Electrical Safety CodeMSHA 30 CFR Part 56 & 57.12028

Rio Tinto Safety Standard C2 – Electrical Safety

Rio Tinto Electrical Standards Guideline Document

REVISION HISTORY:

MOC#	Description of Change	Prepared By	Date
12584	Scheduled review and update including adding a procedure for continuity and resistance testing recommended by the C2 Standards Committee. Also, updated format and Document number added.	KUC Safety and Health Standards Committee	6/10

Exhibit 16.10.1

Procedure for Testing Continuity and Resistance of Grounding Systems

Continuity and resistance of grounding systems shall be tested immediately after installation, repair, or modification; and annually thereafter. A record of the resistance measured during the most recent test shall be made available for inspection and records shall be kept on file in accordance with the KUC records retention policy.

Fixed Plant Equipment**Annual Inspection****(A) Equipment Needed**

- a. Digital or analog volt-ohmmeter
- b. Spool of copper wire of appropriate length with alligator clamps or equivalent suitable connectors at each end

(B) Zero Meter Through Wire Roll

- a. Attach one end of wire to meter
- b. Attach opposite end of wire to other meter probe
- c. Measure resistance of wire
- d. Adjust meter reading to "0" or record reading to deduct from overall resistance readings

(C) Visually Inspect Grounding System and Repair as Needed

- a. Check for obvious signs of corrosion
- b. Check for broken conduit or flex
- c. If external grounds are present, inspect for damage

(D) Record Meter Reading at Motor

- a. Attach one end of wire roll to grounded building steel ensuring good contact
- b. String out sufficient wire to reach motor and attach to meter probe
- c. Place other meter probe on motor housing ensuring good contact
- d. Record meter reading to the nearest 0.1 ohm (deduct wire roll resistance if meter not "zeroed")
- e. If resistance is higher than one (1) ohm, identify and correct deficiency

(E) Clamp on Ground meter

- a. A ground resistance tester may be used in lieu of the above method to measure the resistance of the grounding system

Repair or Modification**(A) Measure the Resistance of the equipment grounding conductor when disconnected**

- a. Use method A-D above but connect one probe of meter directly to the grounding conductor instead of the motor case
- b. After the motor is connected and before energizing measure resistance of grounding system using A – E above (Annual Inspection)

(B) Whenever grounding connections are visible or exposed during routine maintenance or troubleshooting, the grounding connections must be visually inspected.

Portable Equipment - If not connected to a ground monitoring system

(A) Equipment Needed

- a. Digital or analog volt-ohmmeter
- b. Spool of copper wire of appropriate length with alligator clamps or equivalent connector at each end

(B) Zero Meter Through Wire Roll

- a. Attach one end of wire to meter
- b. Attach opposite end of wire to other meter probe
- c. Adjust meter reading to "0" or record reading to deduct from overall resistance readings

(C) Visually Inspect Grounding System

- a. Check for obvious signs of corrosion
- b. Inspect feeder cable and connections for damage

(D) Record Meter Reading at Motor

- a. Attach one end of wire to the MCC ground feeding the power cable, ensuring good contact
- b. String out sufficient wire to reach motor and attach to meter probe
- c. Place other meter probe on motor housing ensuring good contact
- d. Record meter reading to the nearest 0.1 ohm (deduct wire roll resistance if meter not "zeroed")
- e. If resistance is higher than one ohm, identify and correct deficiency

Grounding Electrode Conductor

The continuity and resistance of the equipment grounding conductors shall be measured by an inductive device or resistance reading between the frame of the motor and grounded building steel with a resistance of less than one (1) ohm

Grounding Electrode

The resistance of the grounding electrode or grounding electrode conductor to the earth shall be measured either by reference to an established earth-grounded electrode or inductive device (clamp on ground meter) with a resistance of less than 25 ohms

Building Steel to Grounding Electrode Conductor

The conductors between the building steel and the ground grid shall be visually inspected and the resistance determined by either an inductive device or a resistance meter between the building steel and the grounding electrode. Exposed steel to grid conductors should be visually examined for the condition of bonds and wiring, and of these, a representative number should be measured.

Inspection or Repair

When electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures and motor control centers cabinet are accessed for inspection or repair, a visual inspection of the equipment grounding conductors shall be conducted.

