



SAFETY ALERT

Electric shock and arcing results from ineffective earthing

INCIDENT

Two incident investigations involving phase-to-earth faults on 1000 volt equipment in the hazardous zone at different underground mines have identified ineffective earth connections in Restrained Cable Plugs and Restrained Coupler Receptacles.

Incident 1: Power supply to an electrically powered hydraulic pump tripped on earth leakage and an operator found the handle of a jacking screw on a Restrained Coupler Receptacle (Back to Back) 'tack' welded to steel rib support mesh.

Incident 2: Power supply to a continuous miner tripped on earth leakage and a mine worker received a severe electric shock. The mine worker was resting his left forearm on the rear of the miner and grasping a sheet of rib support mesh with his (gloved) right hand. The victim was transported to hospital in accordance with the mine's electric shock protocol and was allowed to leave after medical tests and examination determined that no permanent injury had occurred as a result of the shock and there was minimal risk of delayed arrhythmia.

CIRCUMSTANCES

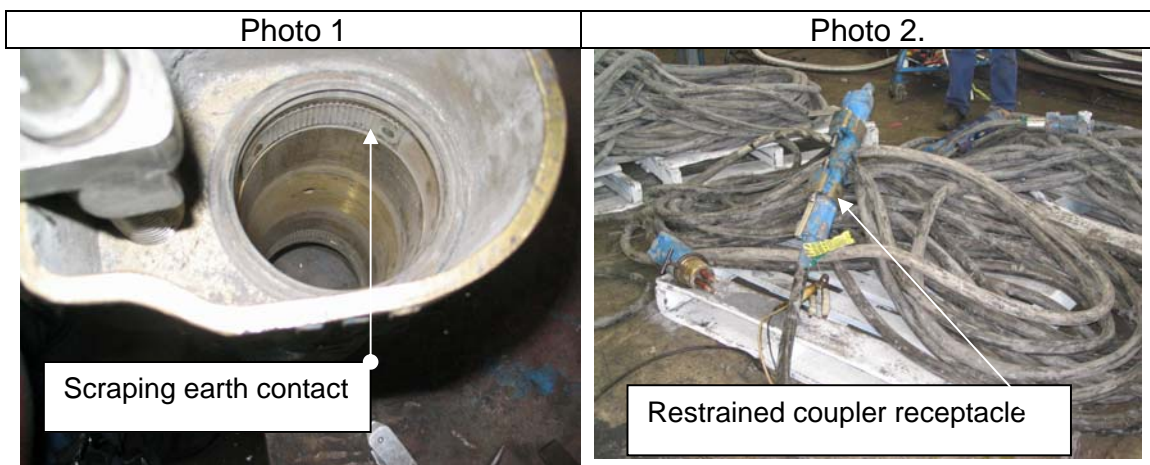
Incident 1: The scraping earth connection between the plug earth sleeve and receptacle body was not continuously effective.

Incident 2: A trailing cable plug was found to have an ineffective earth connection inside the plug body between the earth sleeve and the earth attachment ring mounted on the moulded interior. Earth leakage trip times had an intentional and unauthorised delay. The earth continuity relay was set for pilot control however the external circuit was not wired for pilot control. (Drop-out resistance is increased approximately 300 per cent).

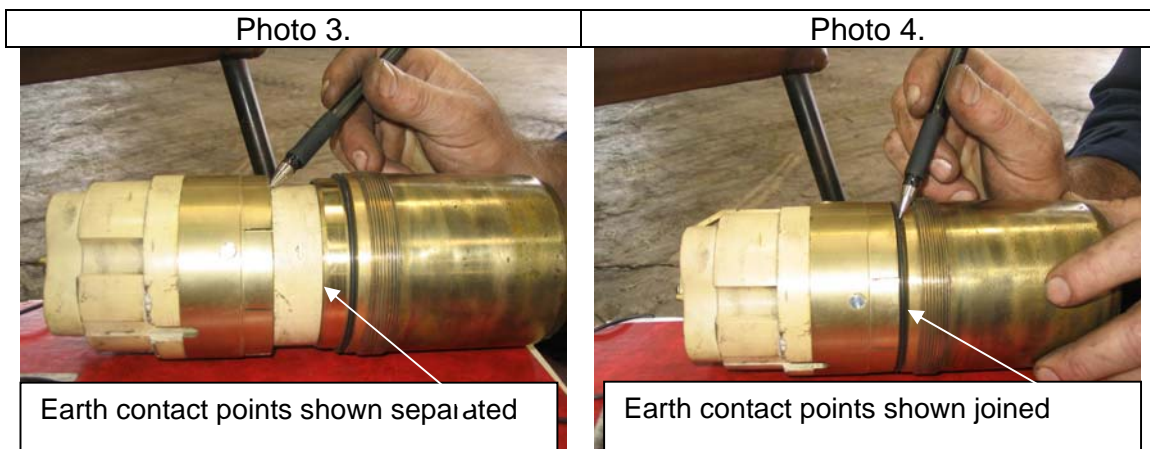
Note: The earth limiting device was a reactor. Reactors are permitted and in common use, however they allow significantly higher inrush current than a resistor.

INVESTIGATION

- 1) The back-to-back coupler (photos 1 and 2) was examined and the scraping earth did not comply with Australian Standard AS1299. (Other receptacles utilising this scraping earth design may potentially have similar non-conformance.)



- 2) The cable plug (photos 3 and 4) was disassembled and the earth sleeve was found to have an unreliable contact with the earth ring attached to the moulded interior. (Other plugs utilising sliding or butt internal earthing connections may potentially have poor electrical integrity).



RECOMMENDATIONS

- 1) Mines should immediately inspect equipment in service to confirm integrity of earth connections.
- 2) Mines must ensure that tripping times for earth leakage relays and earth continuity relays are set to minimum values to achieve adequate prospective touch voltage/operating time characteristics.
- 3) Routine testing and recording of earth continuity must be carried out by competent people at a frequency sufficient to ensure that:
 - a. The earthing resistance is in accordance with the protective requirements and continuously effective, and
 - b. Earth fault currents and earth leakage currents will be carried without danger to persons from electric shock, effects of arcing or fire.
- 4) Manufacturers should immediately investigate the effectiveness of earthing arrangements used on plug and receptacle products and arrange for the provision of adequate information to recipients of the product, to ensure safe use. In particular, information on tests and inspections to assess ongoing compliance with AS1299.
- 5) Cable Repair Workshops and Approved Workshops receiving receptacles and cables of these types for repair should apply information from the product manufacturers to assess the compliance of product and mechanical integrity of scraping and internal earth connections.

Further information on earthing and protection based on the incidents can be obtained from the NSW DPI website at www.minerals.nsw.gov.au/safety.

Signed



Rob Regan
DIRECTOR
MINE SAFETY OPERATIONS BRANCH
NSW DEPARTMENT OF PRIMARY INDUSTRIES

View more safety alerts at www.minerals.nsw.gov.au. If you would like to receive safety alerts by email, send your details to safetyalert@minerals.nsw.gov.au.