

## Electric Shock Investigations

Technicians involved in the investigating electric shock incidents need high quality test equipment in order to quickly identify the cause and thereby prevent further injuries. The PowerMonic 45 is an excellent logger to assist in investigations, especially with its voltage channel for logging shock.

### Causes

Causes of electric shock include the following:

- Raised neutral-earth voltages caused by
  - Poor or open circuit neutral connections in the grid or within an electricity users installation
  - Long runs of neutral conductor in the grid or within an electricity users installation
  - Reverse polarity connection of an installation or at another installation
  - Overloading of the neutral conductor because of
  - Faulty wiring or equipment that has not tripped circuit protection
- Touching fallen powerlines
- Roofs on which a nail or screw has punctured an energized electricity cable
- Faulty wiring or equipment
- Misuse of electrical equipment
- Low energy shocks such as static, induced voltages or leakage through a high impedance path.

### Impact of Electrical Shocks

Most of us know what a comparatively mild shock feels like. Of course, more severe shocks can have devastating effects and even be life-threatening.

Animals may also be affected by electric shocks. Large animals such as cows and horses are affected by step voltages much more than people due to the large distance between their front and back legs. Dairy cows may suffer from nervousness, excessive defecation and urination, reduced milk supply, and may develop elevated mastitis counts even if only receiving very minor shocks.

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Shocks can also harm equipment. A poor or open circuit neutral connection or a long run of neutral wire can result in low and/or high voltages that damage electrical equipment. In addition, a reverse polarity of a multiphase installation can result in severe electric shocks and phase-to-phase voltage being applied to phase-to-neutral equipment. This can cause damage or even ignite a fire.

### **Required Standard for Touch Voltage (Australia)**

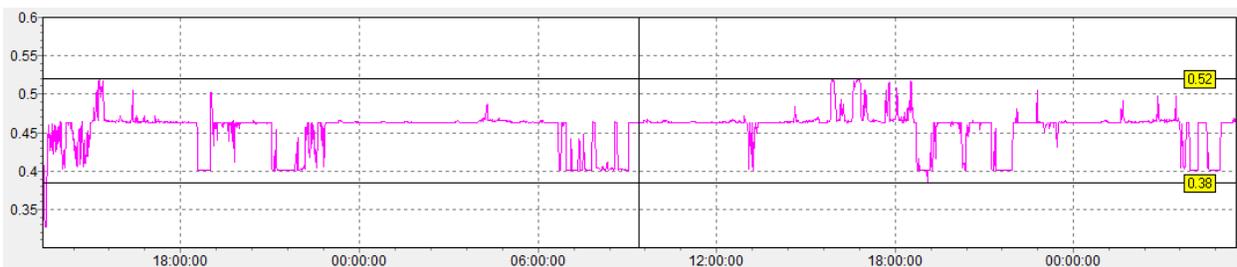
AS/NZS60479 details the effects of electric current on human beings and livestock. However, it does not set acceptable levels for touch voltage, which is defined as “the potential (voltage) difference between a grounded metallic structure and a point on the earth 1 meter from the structure.” IEC 61200-413 provides curves with limits of touch voltage that can be sustained indefinitely depending on normal or wet conditions. However, those limits can result in a nasty shock. Many Australian distributors rely on a limit of 10 volts or less for neutral-earth voltages.

### **Case in Point**

For two months, an urban-dwelling customer had been receiving electric shocks in the shower. A trained technician investigated and found minor voltages of up to 3 volts in the shower when all the load in the customer’s installation was turned on.

Further investigations found that a neutral connection in the street mains was open circuit. The neutral current was forced to take alternate paths back to the distribution transformer, which resulted in above-normal neutral conductor voltage. This voltage was then transferred to the water pipes by the equipotential earthing bond.

A PowerMonic 45 was connected to monitor the neutral-earth voltage at the customer’s installation to ensure that all was back to normal. The logger was removed one day later and downloaded. Fig. 1 below shows the results of that download with the neutral-earth voltage peaking at 0.52 volts, which meant that the problem had been rectified. The customer confirmed the absence of shocks in the shower.



**Figure 1. PowerMonic 45 neutral-earth voltage trace showing very minor voltage levels**