

first common misconception which many people hold is that there is no risk here: the lantern is earthed and therefore the technician is not at risk. But that is only part of the story, and it is important to understand the full picture as it can apply in many parts of theatre installations. A significant risk remains.

COMMON MISCONCEPTIONS

The first misconception is that as the metal lantern is earthed nothing can go wrong; somehow the electricity is magically contained within the lamp and nothing happens. The other misconception is that somehow the electrical power will be disconnected instantaneously. Unfortunately, Stickman has been a bit silly because he couldn't easily access the dip trap near where he is rigging this lantern, so he has run 20 metres of 1.5 mm² cable up to the grid to find an outlet – not an unusual distance in some installations. As

resistance in the live line and the resistance back to earth will be fairly similar, creating a potential divider at the case of the lantern. On a 230 volt supply, these equal impedances will result in 115 volts on the case. If you are unlucky enough to be working in an installation with a poor earth connection, which is possible, it could be a higher voltage. This could really ruin Stickman's day because he is very likely to get a fatal shock. So what can we do about it? Although he is on a wooden floor, he has got one arm connected to earth via the seating unit because that is sitting in a building which is generally at earth potential and his other hand is on something like 100+ volts which is also referenced to earth. So that voltage is going to appear completely across his body and the impedance of his skin and his body is likely to be reduced because he is in a hot, sweaty theatre.

So do not assume that the metal case of your appliance, probably a luminaire in this case, is going to be at earth potential. Remember also that the use of extension leads will increase the impedance and also the disconnect time, quite possibly above the safe 0.4 of a second. This is particularly true in old installations where the fuse-protected dimmers have been replaced by dimmers with MCBs. Remember that to design wiring for an MCB disconnect time below 0.4 sec in the UK and on similar installations, you will need much larger wiring – as Mark said, perhaps up to 6 mm².

ESSENTIAL ACTION

What can we do to improve matters? The first thing we can do is what we should have done anyway, because the IEE Wiring Regulations require all exposed metalwork to be bonded directly back to the main earth terminal. This is the first point at which you can access the earth connection as it comes into your building. This is the red line shown on diagram (2).

This is immediately going to reduce the voltage across Stickman. The fault current will be the same, but the voltage created by it flowing through the external path, that is ZE2, will not actually now appear across Stickman. Brilliant! In most domestic situations, this bonding makes a lot of difference. But unfortunately, in this particular scenario, it doesn't help that much because R2 is part of the earth circuit inside the building a lot of which is in this 20-metre ratio of those two may be

The practical aspects of building services engineering as they relate to theatres and performance spaces are covered by engineer Mark White, consultant David Ludlam and services engineer Colin Darlington. Here David Ludlam explains the importance of equipotential bonding and other electrical safety issues.

Why Equipotential Bonding Matters

- The physiology of electric shock (230V)
- Current kills
- Touch voltage < 50V a.c. is considered safe
- Shock duration < 0.4 secs is considered safe
- Body impedance reduces with increasing voltage
- A fall due to an electric shock can be what kills

bonding taken to an e that a voltage could appear across poor old Stickman. This is shown as the local bonding in diagram (3). While most people would not think of doing that throughout a theatre, they should certainly consider it where the nearest significant earth point is the seating unit.

This probably will not be the main earth terminal of the building but it could be the main earth point on the distribution board feeding the dimmers. Or it could be the metalwork in the grid or other structural steelwork adjacent to the seating unit. And

3 Addition of further equipotential bond minimises touch voltage

