

Re: Human Electrocutation: How is the resistance not ridiculously high?

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In <97de30be-74bd-456b-96ca-ba2ce8b96024@xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx>, Tomás Ó hÉilidhe wrote:

I've been doing electronics for three years now but I don't understand how a person can be electrocuted by touching one part of the circuit in a mains supply.

If I hold one lead of an ohmmeter in my left hand, and the other in my right hand, it registers the resistance to be approximately 2 megaohms, which is ridiculously high.

I do find readings like this for this situation to be common.

Now, for some factors to complicate this:

1. Skin being just a little on the moist side – due to body chemistry, mood, recent past activity, body response to ambient temperature and humidity – it's a little common for this to be a few hundred K-ohms rather than a couple megohms. Occasionally this kind of reading can get down to 50K ohms or so.
2. Current in the roughly-1-milliamp range or more can do a few things to make the resistance decrease:
 - a) Stimulate sweat glands – especially if the current is AC or pulsating DC of frequency probably anywhere in/near the lower half of the audio range, especially 50/60/100/120 Hz
 - b) Cause electrolysis that results in a decrease in contact resistance over time.

Try holding tightly two bare wires coming from a DC power supply of voltage of whatever voltage is low enough for you to assume is safe and not have yourself or next of kin sue me over if things go wrong in any way, with a milliammeter or microammeter in series with the current path. If that voltage is around/above 12 volts, see if that current stays

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steadily low or starts increasing.
Imagine what could happen at 120 volts.

c) At/near 120 volts or more, localized heating could occur at skin contact points. Skin and body fluids generally have negative temperature coefficients for their resistance, especially skin.

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Other things to consider:

1. You may get accidentally shocked or shocked by malfunctioning equipment with skin contact area larger than that typical with handling of ohmmeter leads.
2. You could get such a shock if sweaty or otherwise wet.
3. The most-widely-mentioned "fatal range" of current, for causing ventricular fibrillation, is 100 mA to 1 amp for an arm-to-arm or arm-to-leg shock with 50-60 Hz AC. (Increase of current past 1 amp has fatality rate less than that of .1-1 amp, in case of arm-to-arm shock with "power line frequency AC", but there is still some fatality rate from outright cardiac arrest - plus risk of vital organs getting outright cooked.)

This is merely a "most deadly range", with the "deadliness" not dropping to zero at 99 or 90 mA. Some sources say 50 mA is the lower end of the range of having a fairly significant chance of causing ventricular fibrillation from an arm-to-arm shock, and a small number of sources say that 30 milliamp neon sign transformers (which have current-limiting means, unlike most transformers that are not "lamp ballasts") have a bit of a body count!

For that matter, I have seen one bit saying that there is some chance of fatality at currents as low as around 5 mA - from someone being paralyzed by the shock, with paralysis including paralysis of breathing muscles.

Keep in mind that shock causing someone to involuntarily maintaining a position that maintains exposure to the shock is widely said to be worse with DC, but is actually worse with AC (or pulsating DC as opposed to steady DC). Steady DC is "less-shocking", since most effects of electric shock result from variation of current.

The horror stories from people receiving severe electrical burns on (and also inside) their bodies mostly involve those zapped with either DC or radio frequencies - so that they survive to tell the horrors!

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Keep in mind that electrocutation can get unreliable. The "Electric Chair" appears to me designed to rely on the jolt either cooking vital organs, and/or paralyzing breathing muscles (and preferably also the

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heart) long enough to have the brain deprived of oxygen severely enough to be unable to restart breathing when the jolt stops.
Sometimes the condemned is subjected to more than one jolt.

As unreliable as electrocution is, lack of fatality from electric shock is similarly unreliable.

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The human body is a 470K-ohm 1/4 watt resistor with tolerance of +5000/-98 % and a negative temperature coefficient!

(I don't know who started this, and I could easily be "off" with the numbers somewhat for that one)

- Don Klipstein (don@xxxxxxxxx)

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