

## Electric Shock from the Neutral

Mike, I recently read the story of a man getting shocked by the "neutral" on some fluorescent lighting circuit. I would like you to remind people that the neutral can be very dangerous. One thing we teach our people is to get in to the habit of making up the grounds first, the neutrals second, and the hot wires last. That way if for some reason they are ever working something while it is energized (live) it will be grounded and they become the neutral (get in series with the neutral). By the way, YOU do not have to be grounded to get a good jolt from a neutral!!!

Submitted by Mike Holmes  
MICAWANE@aol.com

**Mike Holt's Comment No. 1:** I almost was killed the same way! I made up the hots first (no ground wires, the conduit and box was metal); then when I started to strip the neutral (right hand holding my side cutters and the left hand on the box for leverage with my thumb on my side cutters) I became in series with a 277 volt lighting circuit (one switch was bad, even though it was off, the internal contacts were closed). I was shaking and telling myself to let go, but I could not and I could not scream. Fortunately, my legs gave way and I fell 6 feet to the ground. It hurt, but at least I was still alive. I will never forget that experience and I learned two things:

1. TURN OFF THE POWER.
2. Make up the grounds first, then the neutrals, and then the hots.

**Mike Holt's Comment No. 2:** I was involved in a case where a sign installer was making the connections of two blacks and two white wires while energized. The sign installer connected the two black wires first, then made contact with the two white wires (got in series with the neutral). He died and left a young wife with two young children. It was a real tragedy.

### Why the danger?

When you become in series with the circuit (between two white wires) the voltage drop of the circuit is among all of the resistors of the circuit, including you! The current flow of the circuit will be through the human body (part of the series circuit) and if the voltage through the body is over 30 volts or 10 millamperes, the potential to send the heart into ventricular fibrillation (results in death) is very real.

**Example:** Lets say you are in series with a 75 watt light bulb rated 120 volts.

Step 1. Calculate the total resistance of the series circuit.

Lamp -  $R = E^2/P$ , or  $R = 120\text{volts}^2/75 \text{ watts}$ , or  $R = 200 \text{ ohms}$  (approximately)

Human body - Lets say 1000 ohms (depending on the person and contact resistance)

Total resistance (light bulb of 200 ohms and a human of 1000) = 1200 ohms.

Step 2. Calculate the current flow of the circuit (through the human body).

$I = E/R$ , or  $I = 120 \text{ volts}/1200 \text{ ohms}$ , or  $I = .1 \text{ amperes}$  or 100 millamperes

Step 3. Determine the voltage distribution among the resistors.

Voltage Drop of the Light Bulb =  $IR$ , or  $E = .1 \text{ amperes} \times 200 \text{ ohms}$ ,  $E = 20 \text{ volts}$

Voltage Drop of the Human =  $IR$ , or  $E = .1 \text{ amperes} \times 1000 \text{ ohms}$ ,  $E = 100 \text{ volts}$

### **Response No. 1**

Mike the stories you posted about the dangers of shock, or electrocution by the neutral brought out a point that I have tried to get across to every one that works with, or for me for years. We need to remember that the neutral is a current carrying conductor.

When we are dealing with florescent lighting the danger is compounded by the ballast, which is an autotransformer. The grounded side of an autotransformer has a direct connection to the high side windings. Florescent ballasts also add harmonics, which can intensify the effect that the current has on the human body.

I personally spent three days on a cardiac ward about thirteen years ago after getting in line on the neutral side of VHO florescent ballasts. After contacting the two white wires I was unable to let go. Only when I passed out and fell from an 8' ladder did I lose contact with it. Fortunately, the mall security heard me fall and came to see what was wrong, or no one would have been there to revive me. The current that passed through my body turned off my liver and kidneys.

After a couple of hours the injuries were again becoming life threatening, and the hospital worked to get them to started again. At the time of my injuries, I had been an electrician for fourteen years, and I felt that I was more than qualified to work on these circuits while they ere energized. My mistake was in not checking the two other circuits that shared that neutral.

The only way to make an installation safe is to turn off the power, then make all of the necessary connections. We have to get away from our old macho way of thinking ("I can do it hot"). There is no amount of money, or saved time that is worth risking even one life to work it hot. The company I work for has made this there policy and has all but eliminated accidental shocks of any kind. Customers will complain that turning off the circuits will inconvenience them, but it is a small thing as compared to the investigation into a fatal accident, the lawsuits that will follow, the lose of a love one. I do not ever want to explain to someone's wife or kids why their husband or father will not be returning to them again.  
Michael White, Mwhite2690@aol.

### **Response No. 2**

Mike, all this talk about hot neutrals reminds me of an experience. I was lucky. I was maintaining a generator and wanted to tighten up a lug on the neutral. I Checked voltage to ground and the meter said there was none. What I didn't know at the time is that checking neutral to ground on a wye wound alternator is just like checking the same phase. There is no potential to be read. A contractor suggested that I check for current, so I clamped on my meter and was humbled to see 2 amps of current flowing through the neutral. The lesson learned. Never check a neutral with a voltmeter, it may not read anything. Instead, clamp on n ammeter or put and ammeter in series to ground. Where there's smoke there's fire and where there's current, you can bet there is voltage.

Christopher King