Electrical Hazards & Laboratory Practice

Safety Note!

- **Electricity is dangerous. Whenever you use electrical appliances and equipment whether at home or at work, there is always a risk of accidents, especially of getting electric shock.**

General Safety Rules

- When working in the electrical laboratory, observe proper safety precautions.
- There are potential hazards in the electrical labs, and failure to follow the procedures can cause accidents.
- The most common hazard in an electrical lab is electric shock

General Safety Rules

- Never work alone.
- Use instruments and power tools provided with three-wire power tools or double insulated power tools approved by CSA(Canadian Standard Association - www.csa.ca).
- Always shut off power before handling wiring.
- Check all power cords for sign of damage.
- Always wear shoes.
- Never handle electrical instruments when your skin is wet

General Safety Rules

- Hot soldering irons should not be left unwatched.
- Never wear loose clothing around machinery.
- Make sure that there is adequate illumination for the task area.
- Assume that all capacitors are charged.
- Periodically inspect insulation
- Verify circuit voltages before performing work
- Do not use water to put out an electrical fire
- Use fuses and circuit breakers for protection against excessive current

Extension Cords

- 2500 workplace injuries annually are tied to improper use of cords.
  - Never use en extension cord for an extended period of time
  - Never cover extension cords with rugs, mats in an attempt to prevent tipping – hide shorts and bare spots.
  - Never just unplug an extension cord that feels hot in order to cool it down.

ICT Safety Rules

- Students are expected to conduct themselves in a professional and safe manner at all times.
- While in the ICT Lab, be aware of the nearest fire extinguisher and location of the safety station with its supplies.
- Food or drink is not allowed in ICT labs at any time.
- Safety glasses and other necessary precautionary-safety-equipment will be used or worn. No open toed shoes or sandals. Long hair should be tied back.
- Electrostatic wristbands are required in the labs with ESD sensitive electronics (for example: FPGAs and microcontrollers).
- All laboratory equipment brought into ICT labs must be CSA approved and in good working order. This will require you to inspect your equipment on a consistent basis.
- All laboratory manuals must be originals. Photocopies are forbidden.
- Vandalism of any kind will not be tolerated; students should note that security cameras are in place for the protection of college property and occupant safety.
- Offenders will be subject to the terms of the College's *Student Rights and Responsibilities Policy*.
- Failure to comply with the ICT *Laboratory Code of Behavior* will result in a lab grade of zero (0).

Policy Highlights

- Safety glasses are mandatory in the following labs when the power in ON:
- B1028,A4072,71,73,66,68,69,58,56,60
- Each lab has a safety station, telephone, and a issue sheet
- Student awareness.
- No food or drink.

Safety Station

ON/OFF

Telephone


AVAYA
Emergency use only
Contact
Extension
Emergency
88
Security
2565
Lab Service
2410
ECET
2437
ACS
2617
Tel #
6402
Spkr
Feature
Hold
Redial
Trnsfr
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Electric Shock

- When electric current is passed through the human body, the effect it causes is called electric shock
- The severity of an electric shock varies somewhat with age, sex and physical condition of the victim.
- The threshold of perception of current for most humans is 1mA. The sensation caused by this current level takes the form of an unpleasant tingling or heating at the point of contact.

Effects of various current levels on the human body

Current Intensity 1 second contact	Effect
1 mA	Threshold of perception
5 mA	Accepted as maximum harmless current intensity
10-20 mA	“Let-go” current before sustained muscular contraction
100-300 mA	Ventricular fibrillation will start
6 A	Sustained myocardial contraction. Temporary respiratory paralysis

Low Voltage can also kill

- The severity of the injury can increase the longer the victim is exposed to the shock current. Because of that, even low voltages can be extremely dangerous because the degree of injury depends not only on the amount of current but also on the length of time the body is in contact with the circuit. Some victims have stopped breathing when shocked with currents from voltages as low as 49 volts.

  For example, a shock current of 100 mA applied for 3 seconds can cause injuries as severe as a current of 900 mA applied for a fraction of a second.

The higher the voltage, the more serious the injuries

- A current flow is directly proportional to the voltage supplying the current. That is why the higher the voltage, the higher the shock current flowing through the victim's body. Therefore, the injuries will be more severe.

  At high voltage (i.e. 600 volts), the shock current can be as high as 4 amps. That amount of shock current will damage the hearts and other *internal organs*. In addition, internal blood vessels may clot, and the nerves in the area where the *skin* touches the electrified object may be damaged.

  High voltages can also cause severe *tissue burns*. A strong shock at the *limb* can cause the limb to come off.

First Aid for Electric Shock

- The first step in helping a victim is to shut off power.
- If the attempt fails, try to break the contact of the victim with the power source without injuring yourself.
- Do not touch the victim with your bare hands.
- Call 911

Sources of Electrical Hazards

- Contact with a bare wire carrying current
- Working with equipment that lacks the UL, CSA, or Special Inspection label
- Electrical Equipment that has not been properly grounded
- Working with electrical equipment an damp floors
- Using metal ladders to work on electrical equipment
- Working on electrical equipment without ensuring that the power has been shut off
- Lighting strikes

Incidence of Electrocution

- Electrocution accounts for about 20% of all fatalities in the Canadian construction industry.
- 411 people died from electrocutions in the US 2001 (US Consumer Product Safety)
- Large appliance were responsible for 19% of electrocution deaths in the US 2001 (US Consumer Product Safety)
- Installed household wiring was responsible for 11% of electrocution deaths in the US 2001 (US Consumer Product Safety)

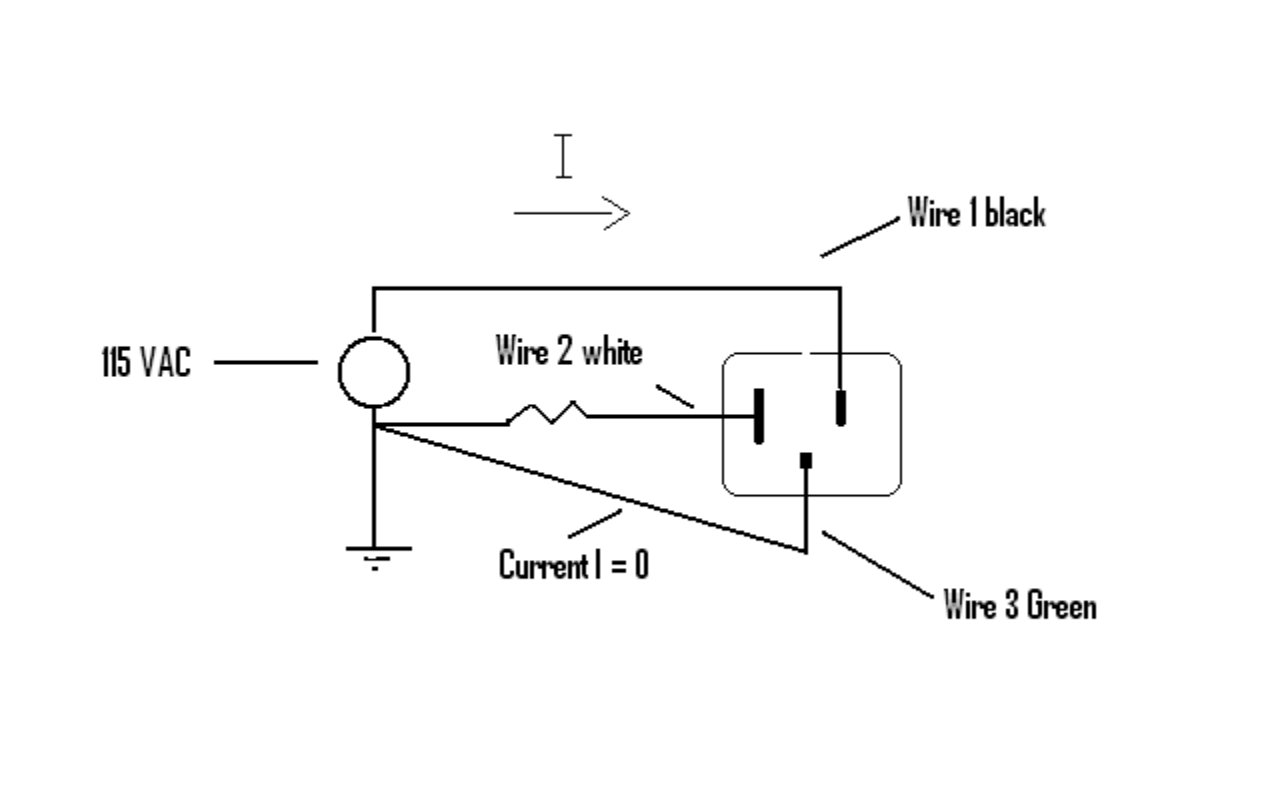
Grounds

- The concept of ground and grounding are basic and integral concepts utilized in the design of electrical measurement systems.
- Measurements of potential difference are relative, the voltage level of any point in a circuit must always be compared to some reference level. This reference level is assigned a voltage of zero and is known as the circuit ground.

Grounds

- Different kinds of grounds: Earth ground, floating chassis ground.
- In the common three-wire wall outlet, there are two wires connected to the ground. Wire 2(white - neutral) is connected to ground and carries the return current from the load back to ground.
- Wire 3 (green) is a non current carrying wire under normal operating conditions. Its purpose is to supply a low resistance path back to the service panel.
- Wire 1 is not connected to ground but is connected to the terminal of higher potential of the ac source. It’s color is usually black or red.

Three Wire Outlet



Grounding

- Ultimately the most important reason for grounding electrical equipment is to provide protection against electrical shocks.
- Electrical instrument and household appliances are built so that their equipment cases are electrically isolated from the wires that carry power to their circuits. This isolation will prevent from equipment from becoming hot.
- The equipment shall be grounded and the operator shall not be grounded

Over Current Protection

- The use of over current protective device (fuse or circuit breakers.

Insulation Failure

- Direct Sunlight
- Sparks or arcs from discharging static electricity – holes in insulation
- Repeated exposure to elevated temperatures
- Contact with abrasive surfaces
- Animals… rodents, insects chewing on insulation
- Moisture and humidity

Detection of Electrical Hazards

- **Circuit tester** – Test equipment with two wire leads capped by probes and connected to small bulb. 110-220 V – On/off
- **Receptacle wiring tester** is a device with two standard plug probes for insertion in an ordinary 110 V outlet.
- **Continuity tester** can be used to determine whether a conductor is properly grounded or has a break in a circuit.

Reducing Electrical Hazards

- **Grounding**
- **Ground fault circuit interrupter** – GFCI – can detect the flow of current to the ground and open the circuit, thereby interrupting the flow of current.
- **Fuses** consists of a metal strip or wire that melts if a current above a specific value is conducted through the metal.
- **Double insulation** is another means of increasing electrical equipment safety. Double insulated tools have a plastic nonconductive housing in addition to standard insulation.
- **Interlocks** automatically break the circuit when an unsafe situation occurs.

Canadian Electrical Standards

- Rules and regulations regarding installation, wiring and maintenance of electrical equipment are covered by the Canadian Electrical Code.

References

- Occupational Health and Safety for Technologist, Engineers, and Managers Canadian Edition by David Goetsch
- Student Reference Manual for Electronic Instrumentation Laboratories by Stanley Wolf