

# WORKSHOP SAFETY

## SCRATCHING THE SURFACE

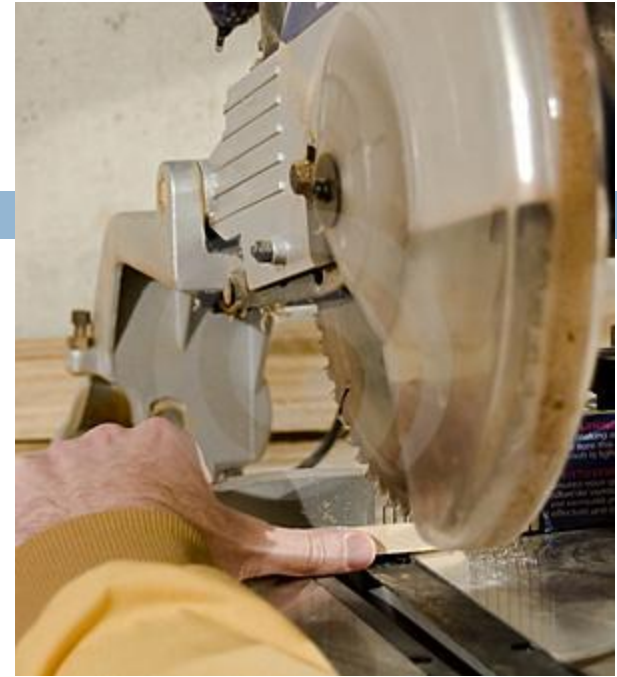


**Niagara  
College  
Canada**

Technology Division

# Why safety?

- Accidents are inevitable!
- You must **REDUCE** the risk of personal injury and disease.
- In Ontario, 2007:
  - ▣ 329,161 serious accidents occurred
  - ▣ 439 are **DEAD**
  - ▣ \$1,430,410,000 incurred cost to employers
  - ▣ \$746,763,000 incurred to our health care system
- This is a **HUGE** problem. **Don't be a statistic!**



# Safety: Topics of discussion

- 1. Being Safety Conscious
- 2. PPE: Personal Protection Equipment
- 3. Good Housekeeping
- 4. Electrical Shock vs. Electrocution
- 5. Avoiding Hazards
- 6. Your Five Senses
- 7. Designing Safety
- 8. Emergency Medical Equipment
- 9. WHMIS



# 1. Being Safety Conscious

- Rule#1: PAY ATTENTION
  - ▣ Concentrate on what you are doing
  - ▣ Do not distract others who are working with dangerous tools
- Before operating equipment, visually inspect if the tool is safe for operation
  - ▣ Ex: Leaving the chuck in the drill press...  
= injury/death
  - ▣ Locked rotor on electrical equipment...  
= fire/explosion
- Report all equipment problems to your instructor or supervisor immediately

# 1. Being Safety Conscious

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- Report any dangerous condition to your instructor or supervisor immediately
- Obey all posted warning signs
- Caution others in violation of safety rules
- Wear your PPE (Personal Protection Equipment)

# 1. Being Safety Conscious

- Assume all electrical circuits are live until you have inspected them yourself.
  - ▣ Ex: High voltages in CRTs, capacitor voltages, any AC system
- Keep your hands dry when working around electrical circuits. Moisture lowers your body resistance and makes you a better current path.



# 1. Being Safety Conscious



- Use the “One hand” method: one hand is placed **BEHIND** your back or in your pocket, while the other is used to measure high voltages. This limits exposure of currents across your chest.
- When possible, place **YOUR** lock on lockouts. This is a device that doesn’t allow energizing a circuit until all locks are removed. Required in industry. Most household breaker panels also have lockouts!

# 1. Being Safety Conscious

- Know where the emergency stations, equipment, and supplies are located. (emergency switches, fire extinguishers, emergency exits, first aid kits, chemical wash stations etc.)
- Keep your arms and back straight and bend your knees when lifting heavy objects. (computers, motors, generators, monitors...) Be sure to get help with heavy objects.
- NEVER engage in horseplay or play practical jokes. They create dangerous situations.

# 1. Being Safety Conscious

- Most employers now require a safety plan to be created before the start of each day on the job.
  - ▣ Allows everyone to become aware of the hazards
  - ▣ Allows concerns to be raised
  - ▣ Allows everyone to know where/how to get help
    - Ex: can't call 911 at Sir. Adam Beck Power Stations, as the call goes to the US. Must call ext. 799
  - ▣ Demonstrates to MOL safe work practices, and is a legal document in case of serious injury.

# 2. PPE



## □ PPE: Personal Protection Equipment

Depends on hazard type, but can be a mixture of:

- ▣ Gloves
- ▣ Hard Hat
- ▣ Safety Shoes
- ▣ Goggles
- ▣ Hearing Protection
- ▣ Respiratory Filters
- ▣ Lab Coat
- ▣ Full Suit
- ▣ Detectors



## 2. PPE

- Safety glasses must be worn around all hazardous conditions. ( i.e. soldering, chemicals, mechanical...)
- For extra protection goggles or a face shield should be worn. (i.e. caustic chemicals, grinding, biological agents)
- Wash your hands thoroughly after using any chemical. (MG Developer, Isopropyl Alcohol, etc.)

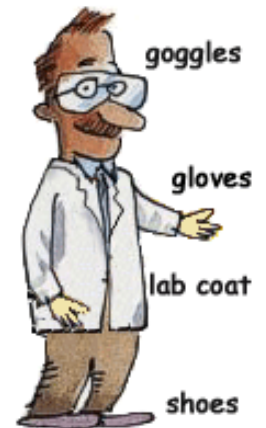


## 2. PPE

- Dress appropriately
  - ▣ **Do not wear shorts!**
  - ▣ **Do not wear open toed shoes!**
  - ▣ Do not wear loose clothing.
  - ▣ Do not wear ties when exposed to rotating equipment.
  - ▣ Tie back long hair or use a hair net.
  - ▣ Do not wear jewellery around rotating equipment or electrical circuits.



VS



## 2. PPE

ALWAYS WEAR YOUR PPE!!!



# 3. Good Housekeeping

- Your work area must be kept neat and clean to avoid the creation of a safety hazard.
- Be sure all floor areas and passageways are free of obstructions.
- Never leave tools where they may cause an injury (soldering iron cord over the edge of the bench).
- Chemicals should be clearly labeled and stored in a secure place, as per WHMIS regulations.
- NEVER take food or drink into a laboratory.

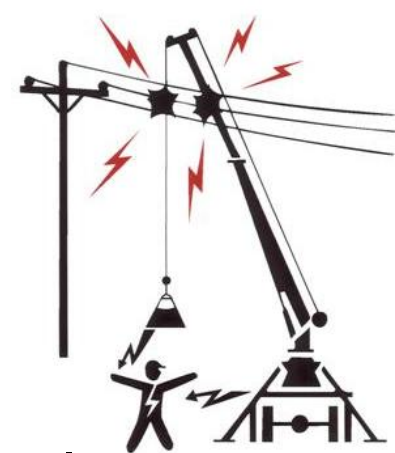


# 3. Good Housekeeping

- When running extension cords along the floor be sure they are out of traffic areas or well protected.
- **Never sweep a bench area with your hand. Use a brush to avoid sharp or jagged objects.**
- Never leave a drawer pulled out, or a cabinet open as this may create an tripping hazard.
- Arrange tools on the workbench for easy access.

# 4. Electrical Shock vs. Electrocution

- Voltage - The force that causes current to flow through a circuit.
- Current - Dependent on the circuit's resistance and the value of the voltage.
- Resistance - opposition to the flow of current.
- Body resistance = 10K to 50K depending on how good a contact you make with the live circuit. (wet skin, cuts, abrasions, sweat, all decrease your body resistance)
- Current kills, not voltage. Voltage is the force that makes current flow through you!



## 4. Electrical Shock vs. Electrocutation

### Threshold of Electrical Sensation To Death

- 10  $\mu$ Amps - the **threshold of sensation**
- 1 mAmps - a **shock** that can be felt as a mild tingling sensation. (5 mAmps - GFCI trip point)
- 10 mAmps – a painful **shock** that can cause temporary muscular paralysis.
- 50 mAmps - a **shock** that can cause severe breathing difficulties and muscular paralysis (can't let go phenomenon) - may be fatal, **120VAC!!!**
- 100 mAmps - produces a **shock** that can cause **death (electrocutation)** if it lasts for a second or more
- $>100$ mAmps – Respiratory & cardiac failure, electrical burns.
- $>20$  Amps – Severe burns, physical dismemberment!

# 4. Electrical Shock vs. Electrocution

- Most common electrocution: 120Vac (wall voltage)
  - ▣ Causes humans to clench hands, can't let go... DEATH
- AC voltages much easier to shock you than DC due to the impedance of your body.
- Voltage arc rule of thumb: 10,000V per inch, less in humid air.



Arm with third degree burn from high-voltage line.



Electrical burn on hand and arm.

# 5. Avoiding Hazards

Five Step Process:

- 1) Identify the hazards first
- 2) Isolate/limit the hazards
- 3) Wear PPE
- 4) Know where to get medical attention
- 5) Review the dangers at the beginning of each shift

# 5. Avoiding Hazards

## Common Hazards to Watch for:

- ❑ If compressed air or a "Dust Blaster" is used for cleaning be sure to wear eye protection, and never let the air stream come in contact with your body. Compressed air can push microscopic contaminants into your skin and blood stream.
- ❑ Secure loose clothing when around any machinery.
- ❑ Don't work on live circuits except when absolutely necessary.
- ❑ One hand in your pocket to measure high voltage.

# 5. Avoiding Hazards

## Common Hazards to Watch for:

- ❑ Dangerous voltages can be held in some devices after the power is removed (CRTs, Power Supplies, Capacitors). Some devices can hold 40,000V for months, like your TV!
- ❑ Hand tools used must be electrically insulated.
- ❑ Read the MSDS for the chemicals you use.
- ❑ Make sure you are familiar with the operation of a power or hand tool before you use it.
- ❑ Arrange tools so that line cords (soldering iron) and sharp edges are not hanging over the edge of the bench.

# 5. Avoiding Hazards

## Common Hazards to Watch for:

- ❑ Never shake molten solder from a soldering iron - use a damp sponge.
- ❑ All decanted chemicals must be clearly labeled.
- ❑ Never take food or drink into the work area.
- ❑ Remove power connections by the cord cap, not the power cord.
- ❑ Long power cables powered by DC currents **WILL** hold a charge after being disconnected. Be sure to drain charge!

# 6. Your Five Senses - Eyes

## Eye injuries can occur from:

- ❑ Clipping component leads - **Safety Glasses**
- ❑ Solder splash - **Safety Glasses**
- ❑ A splash or spray of chemicals - **Safety Glasses, chemical proof goggles or a face shield**
- ❑ A flash of intensely bright light - **Filtered Safety Glasses**
- ❑ Lasers - **Laser Safety Glasses** (wavelength dependant)
- ❑ Compressed air - **Safety Glasses**
- ❑ Power driven machinery and exposed electrical circuits - **Safety Glasses**

# 6. Your Five Senses - Ears

**Loud sounds & high-pitched tones can cause temporary and permanent hearing loss from:**

- ❑ Power tools - **ear plugs or ear muffs**
- ❑ Industrial noise (drop forge, sheet metal cutter, metal stamping machine) - **ear plugs or ear muffs**
- ❑ Aeronautics industry (airports) - **ear plugs or ear muffs**
- ❑ Noise levels and exposure times are governed by the Ontario Health and Safety Act. You may request a noise analysis of your work environment if you believe it is a potential hazard.

# 6. Your Five Senses - Nose

**Respiratory damage can occur to the lungs, nasal passage or respiratory membranes from:**

- Printed Circuit Board chemicals and PCB dust – **Should be drawn from the area by vent hoods and exhaust fans.**
- Microelectronics process chemicals - **drawn from the area by vent hoods and exhaust fans.**
- Contact cleaners, flux removers, etc. - **used in well ventilated areas.**
- When dealing with airborne chemicals, a carbon filter mask may be required to minimize exposure.

# 6. Your Five Senses - Mouth

## Damage to your internal organs could occur from:

- Printed circuit board chemicals on your hands, transfer to your food – **wash your hands.**
- You could be unknowingly ingesting foreign and hazardous particles, such as fiber glass particulate – **wear a dust mask.**
- Acid salts picked up on the hands during a chemical process – **wash your hands, use vent hood.**
- Cleaning solvents & flux removers etc. on the hands – **wash your hands.**
- Absentmindedly using your mouth as a third hand to hold the solder – **don't put anything in your mouth, including gum during laboratory work.**
- Stripping the insulation from a piece of wire with your teeth – **don't put anything in your mouth.**

# 6. Your Five Senses - Mouth

- Contaminants on the hands usually end up in the mouth - nail biting - consuming food.
- Wash your hands after using any chemicals or working in a chemical environment.
- Wear gloves when working with chemicals.
- Use a vice as a third hand or ask for help if you need it during a soldering process.
- Read the MSDS before handling any chemical.

# 6. Your Five Senses – Touch or Skin

## **Injury can cause permanent skin damage from:**

- Nerve endings may be destroyed because of an electrical shock, burns from soldering irons & solder, hot components and chemicals (acids) – **minimize exposure.**
- Acid-proof gloves, an apron and a face shield may be required when working with caustic chemicals.
- Secure loose clothing, use a hair net, and remove all jewelry around power driven machinery and exposed electrical circuits.

# 7. Designing Safety

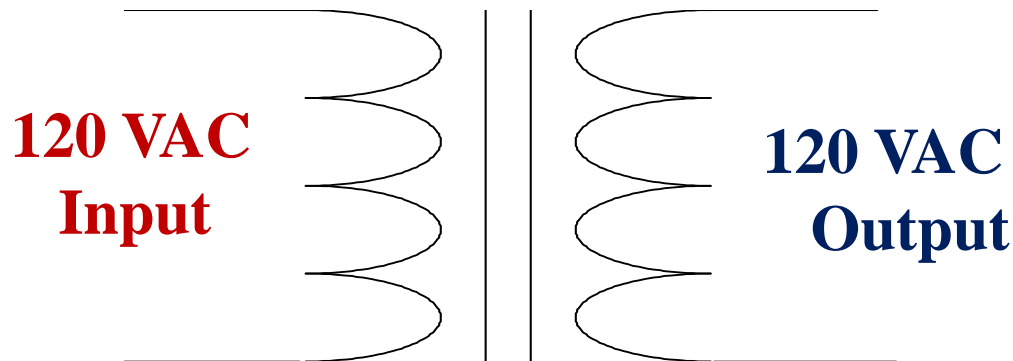
- The Isolation Transformer
- Component polarity
- Fuses
- Three wire power cords
- AC leakage test
- GFCI – Ground Fault Circuit Interrupter
- ESD – Electrostatic Discharge

# 7. Designing Safety

## The Isolation Transformer



- Purpose - to isolate the load from the source, and to isolate the ground reference in the load.
- Accomplished by – One to One transformer.



**GND & Neutral Reference**

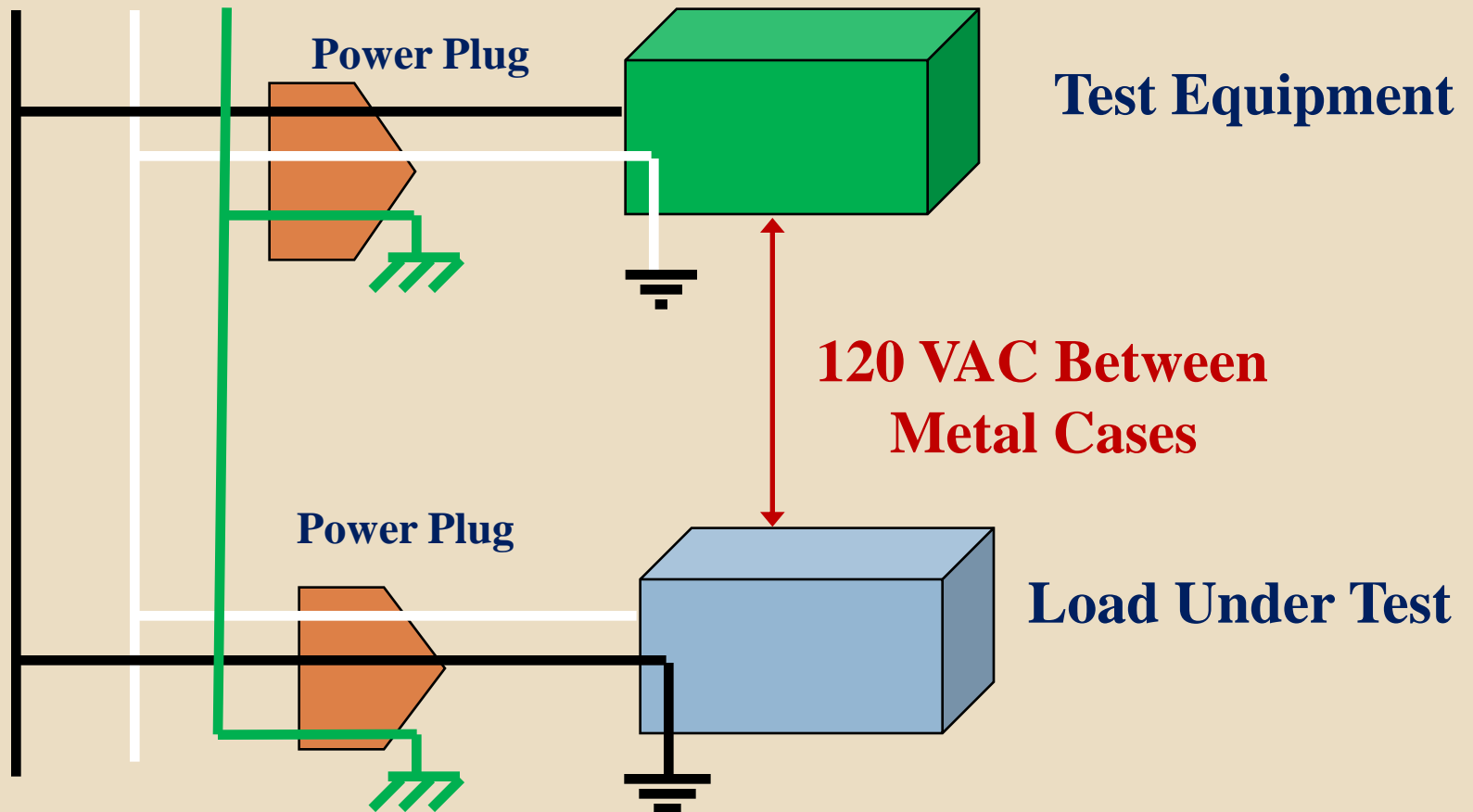
**No GND Reference, Floating GND, thus could touch any side without getting shocked.**

# 7. Designing Safety

## Reference to Neutral Potential

Two pieces of equipment not connected to the same AC neutral.

### 120 VAC Source



# 7. Designing Safety

## Component Polarity

- ❑ Electrolytic capacitors – polarized incorrectly may explode violently!!!
- ❑ Tantalum capacitors - polarized incorrectly may explode violently!!!
- ❑ Semiconductors - polarized incorrectly may burn up in the circuit.



**All these polarity problems may result in fires and flying particles**

# 7. Designing Safety

## Fuses & Breakers

- Fuses are designed to open when a specific current value is exceeded.
- Used to protect circuit against excessive current draw.
- Breakers are designed to be re-settable after being tripped.
- Can be:
  - Slow blow
  - Medium blow
  - Fast/Instantaneous blow
  - Range from  $\mu$ Amps to kAmps



# 7. Designing Safety

## Typical 3Wire Connection

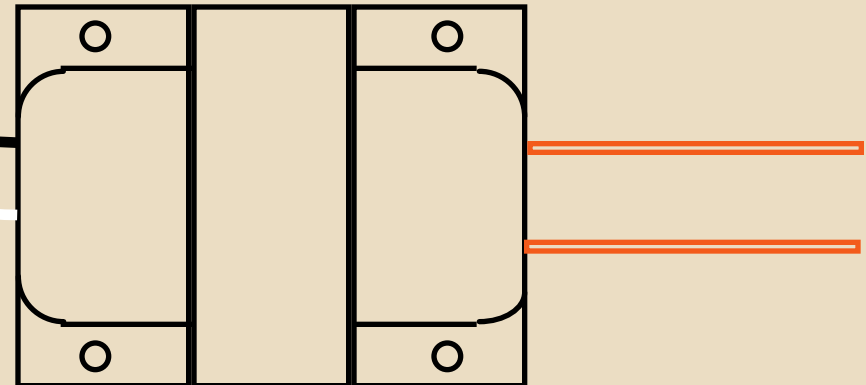
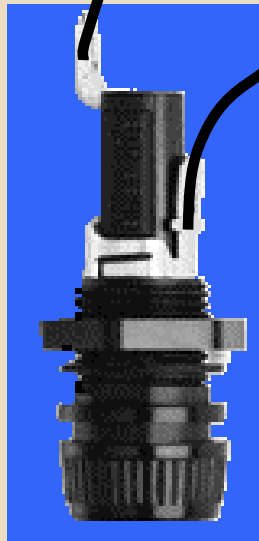
3 Wire Plug



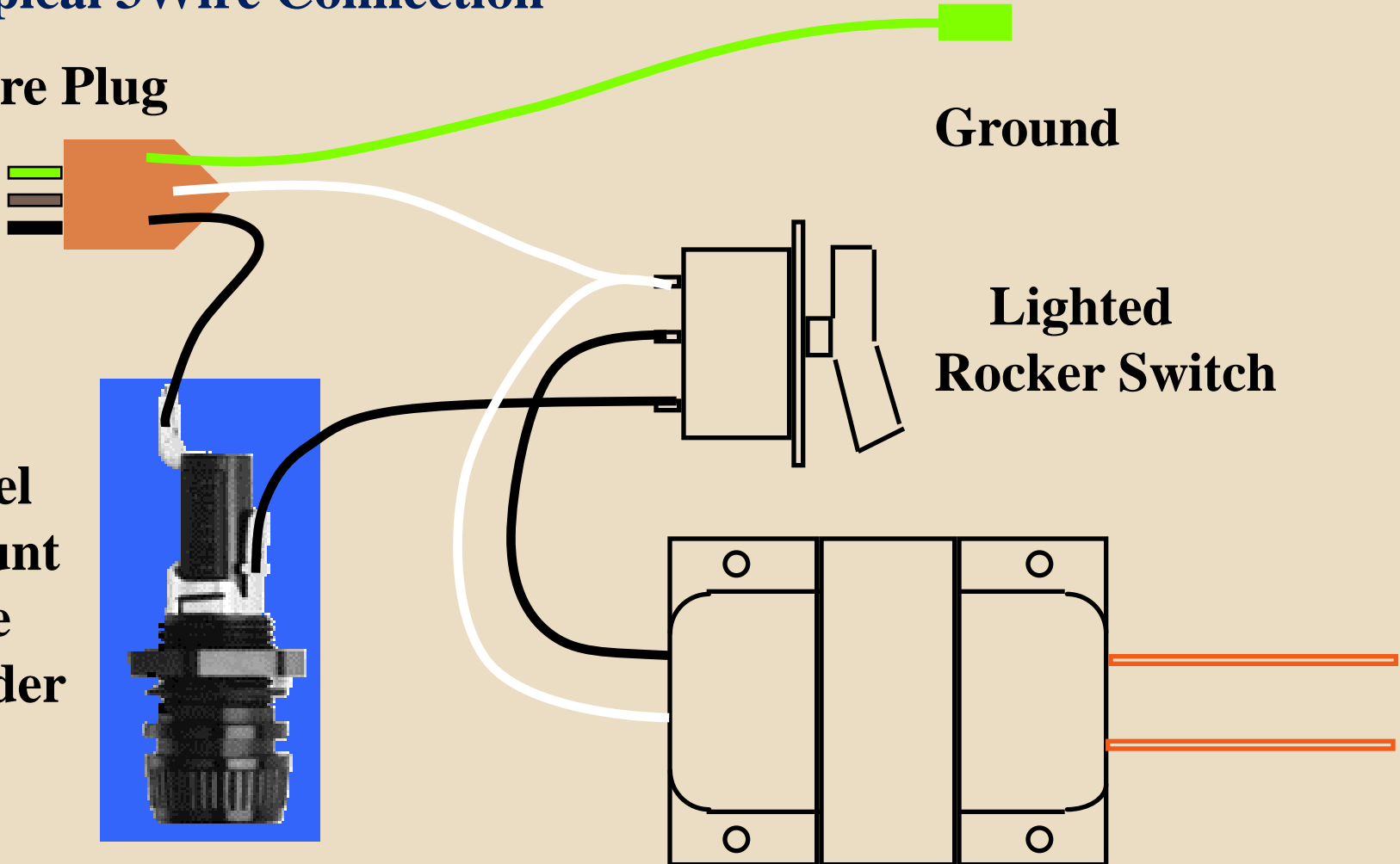
Ground

Lighted  
Rocker Switch

Panel  
Mount  
Fuse  
Holder



Transformer



# 7. Designing Safety

## 120VAC Leakage Test

- No greater than 0.3 Vrms should be measured between the GND and Neutral.
- A Vrms reading of 0.3V represents a current flow of 0.2 mA. Any reading higher than this would indicate a safety hazard.

# 7. Designing Safety

## GFCI – Ground Fault Circuit Interruptor



- GFCIs are designed to measure the input and output current in a circuit. When the difference exceeds 5mA, the circuit is tripped.
- Must trip VERY quickly to protect life.
- REQUIRED in all new kitchen and bath installations.
- Used in any environment exposed to high humidity or water.
- Should be tested periodically.

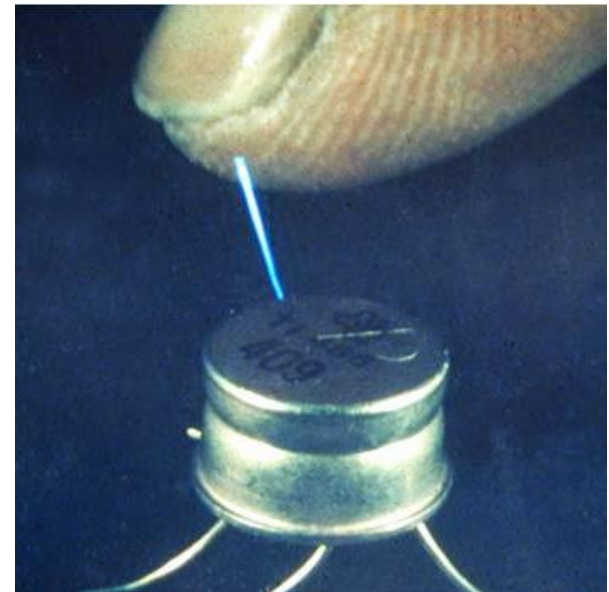


# 7. Designing Safety

## ESD – ElectroStatic Discharge



- **ESD is the transfer of electrons from the surface of one object to another.**
- **Primary source of ESD is from friction between materials**
- **ESD can be as low as 30V and as high as several hundred thousands volts. Typically 1kV to 35kV (humidity dependent).**
- **ESD can permanently damage:**
  - ▣ **CMOS (eg. computer processor...)**
  - ▣ **MOSFETs**
  - ▣ **Transistors**
  - ▣ **Most electronic equipment**



# 7. Designing Safety

## ESD – Electrostatic Discharge

- **Use antistatic materials, antistatic wrist straps, conductive foam – keep all pins of the device at the same potential.**
- **Disconnect the power to the circuit when inserting or removing any devices.**
- **To avoid static discharge from a soldering iron use one with a grounded tip.**



# 8. Emergency Medical Equipment

Know the location of all Emergency Medical Equipment

- Eye wash station\*
- Safety Shower
- First Aid Kit\*
- Spill Containment Kit\*
- Fire Extinguishers\*
- Telephone and Emergency Number\*
- Fire Blankets

\* - Located in V16

# 8. Emergency Medical Equipment

- You should first know how to deal with your hazards – ie, read MSDS first!
- In case of emergency, alert your lab instructor.
- If exposed to dangerous chemicals, have someone call 911, remove clothing and wash skin with COLD water.
- Dispose of clothing and contaminated PPE.
- Consult MSDS for First Aid Measures.
- Get further medical attention when required.
- NOTE: If you wear contacts and experienced eye exposure, use the eye wash first, remove contacts, wash again. **DO NOT RE-USE YOUR CONTACTS!!!!**

# 8. Emergency Medical Equipment

- In the case of an emergency at school, you are to immediately inform your lab instructor, and/or school security via classroom telephones. Dial 6666 (Security) or Dial 0 and ask for security.
- **If you require medical assistance dial 9, then 911.**

# 8. Emergency Medical Equipment

## Types of Fires

A



- **Class A** fires are those fueled by materials that, when they burn, leave a residue in the form of ash, such as paper, wood, cloth, rubber, and certain plastics.

B



- **Class B** fires involve flammable liquids and gasses, such as gasoline, paint thinner, kitchen grease, propane, and acetylene.

C



- **Class C** fires are those that involve energized electrical wiring or equipment (motors, computers, panel boxes)
  - ▣ Note: if the electricity to the equipment is cut, a Class C fire becomes one of the other three types of fires.

D

- **Class D** fires involve exotic metals, such as magnesium, sodium, titanium.

# 8. Emergency Medical Equipment

## Types of Fire Extinguishers



Type of Extinguisher	How It Works	Classes of Fire			
		A	B	C	D
Water	reduces temperature	X		NEVER	
CO2	displaces oxygen		X	X	
Dry Chemical	binds oxygen	X	X	X	
Halon	binds oxygen		X	X	
Met-L-X (Sand)	smothers fire				X

To remember how to use a fire extinguisher, think of **PASS**.

P **P**ull the locking pin.

A **A**im the nozzle at the base of the fire.

S **S**queeze the trigger all the way closed.

S **S**weep the extinguisher discharge side to side over the area of the fire.

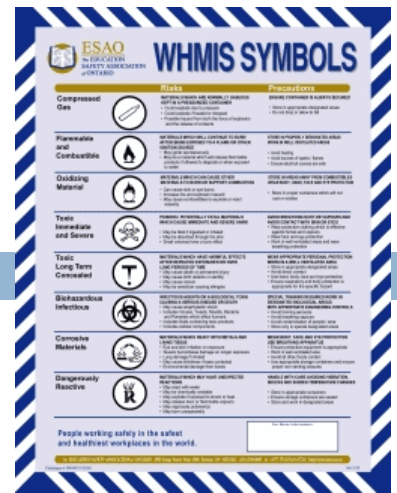
# WHMIS: Workplace Hazardous Materials Information System

- The purpose of WHMIS is to inform/educate the worker of the potential hazards (DANGER) in the workplace.
  - ▣ This is done by providing information about:
    - Safe storage
    - Safe handling
    - How to treat exposures
    - PPE requirements
    - What part of your body is most at risk
    - Labelling of critical information

# How WHMIS Works:

- WHMIS applies to hazardous materials known as controlled products.
- The supplier of the hazardous material provides the labels and MSDS (Material Safety Data Sheets) of the hazard to the employer.
- The employer passes this information to the worker AND provides education to ensure the worker is informed about the WHMIS process.

# WHMIS



- Three things are required:

- **Proper Labelling**

- **Proper MSDS Data Sheets**

- **Proper Education**

- **You cannot handle, use, store or transport hazardous materials in industry/school unless these three requirements are met.**

# WHMIS and the Employer

□ Three (3) duties:

1) Ensure controlled products are labelled or identified.

2) Obtain MSDS sheets for each controlled product

**Note1: Must be updated every 3 years.**

**Note2: Can be on a computer, if employees are trained to get them.**

3) Educate workers.

# What are Controlled Products?

- There are 6 Classes listed under the Act:
  - (CLASS-A) Compressed Gas
  - (CLASS-B) Flammable and Combustible materials
  - (CLASS-C) Oxidizing materials
  - (CLASS-D) Poisonous and Infectious materials
  - (CLASS-E) Corrosive materials
  - (CLASS-F) Dangerously reactive materials



Compressed Gas



Flammable and Combustible Material



Oxidizing Material



1. Materials Causing Immediate and Serious Toxic Effects



2. Materials Causing Other Toxic Effects



3. Biohazardous Infectious Materials



Corrosive Material



Dangerously Reactive Material

WHMIS Classes and Hazard Symbols

# MSDS – Material Safety Data Sheet

- MSDS is a technical document that summarizes the health and safety of information available about the controlled product. It supplements the WHMIS label.
- Workshop lab MSDS information will be covered as needed.
- Note: The MSDS is not intended to provide ALL information about the product or how to safely use it under all conditions. The employer, through education to their employees, are expected to supply information about how to safely handle the product for their specific application.

# Employer Education Programs

- The employer must refresh all workers WHMIS knowledge each year.
- This is done in case some changes have been made.
- New work procedures.
- And review updated MSDSs.

# WHMIS and the Worker **THAT's YOU!**

## □ Workers rights:

- Right to know about hazards they are exposed to in the workplace.
- Right to review labels and MSDS sheets before work is done.
- Right to instruction and training.
- Right to be consulted regarding the development and implementation of the instruction and training.
- **Must review WHMIS annually**

# WHMIS and the worker

- Worker's Responsibilities
  - ▣ Workers are to inform to their employer of missing labels or labels that are illegible.
  - ▣ Workers are to inform their employers of any violation of the Acts or Regulations.



# WHMIS Summary

□ Safety **IS** part of any job.

Five Step Process:

- 1) Identify the hazards first
- 2) Isolate/limit the hazards
- 3) Wear PPE
- 4) Know where to get medical attention
- 5) Review the dangers at the beginning of each shift

**DON'T BE A STATISTIC**

