

ELECTRICAL SAFETY TESTING 101



- General Electrical Safety Compliance
- Electrical shock hazards
- Electricity and human body
- Methods for Electrical Safety testing
- Training Resources

Meet Our Team



Anthony Arroyo

Presenter
Applications Engineer



Syed Abidi

Panelist
Applications Engineer



Brittany Socha

Organizer
Marketing Coordinator



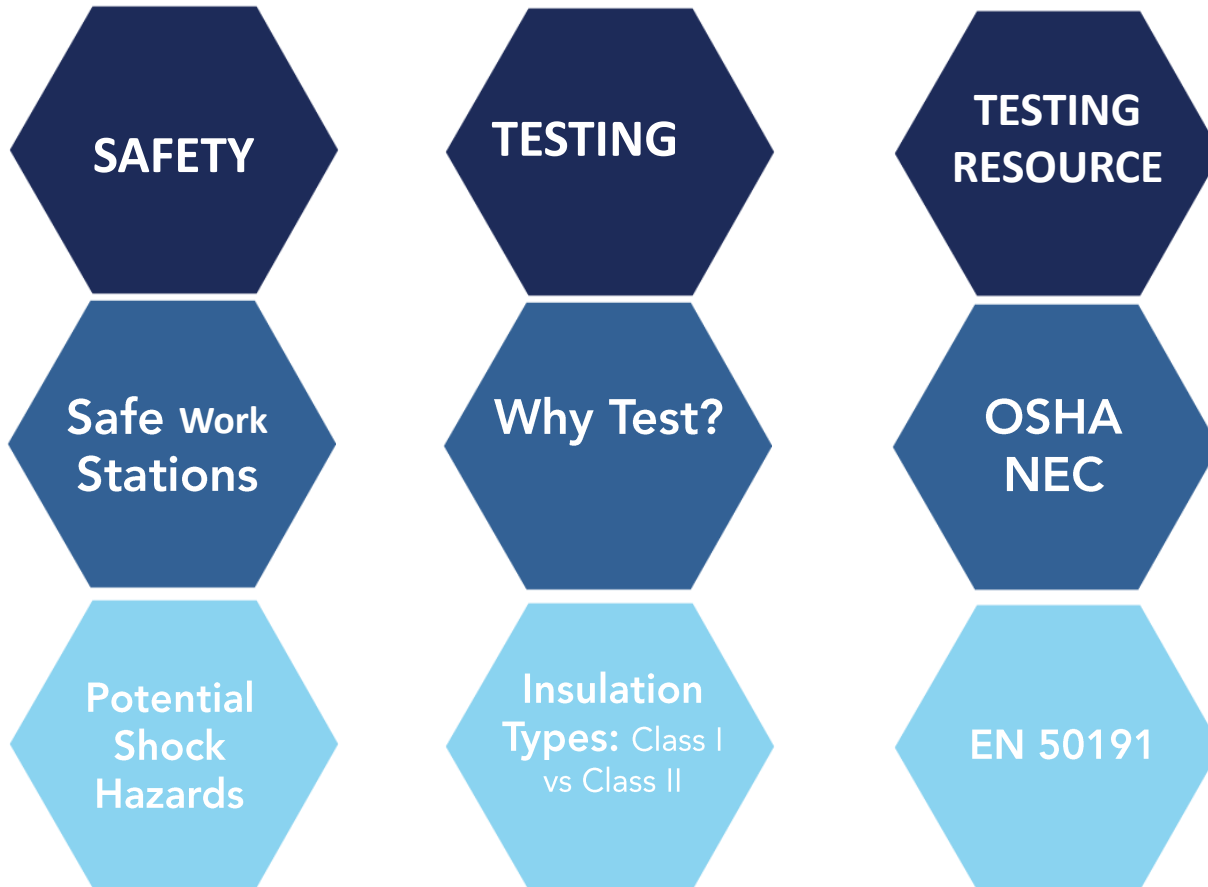
Webinar Notes

Please use the Q & A utility to ask us any questions concerning the material being presented.

Please contact Brittany Socha – on the chat line or email
Brittany.socha@ikonixusa.com if you would like a copy of this presentation.



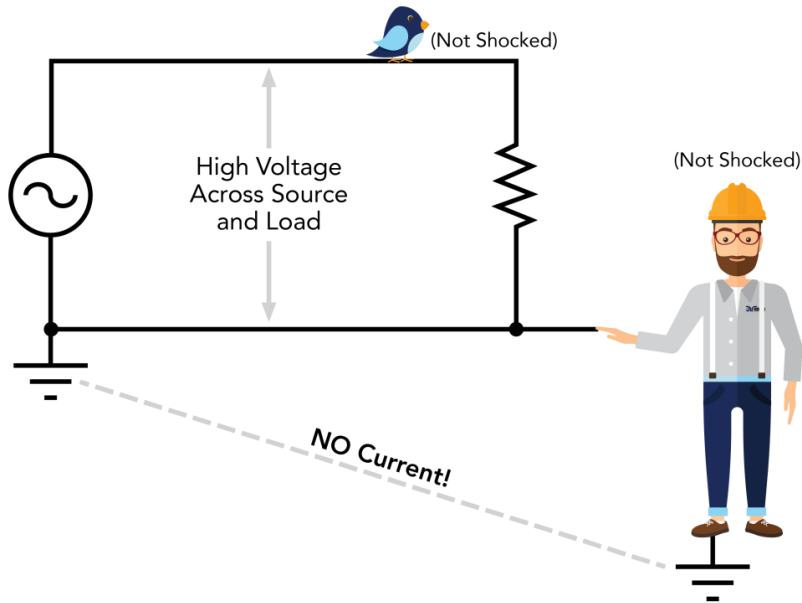
Learning Objectives



Presentation Objectives

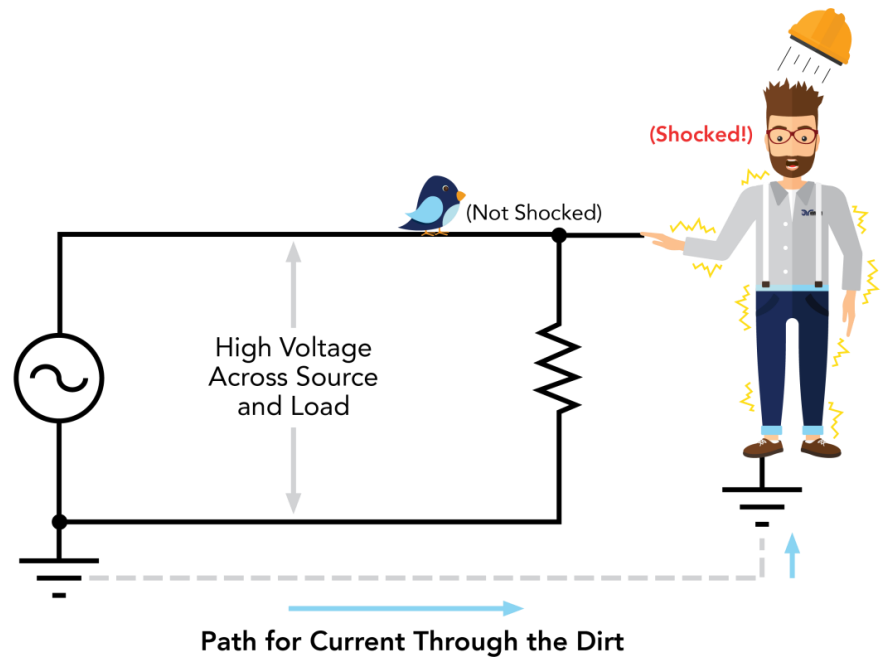
- Recognize an electrical safety hazard
- Setup a safe testing work station
- Find resources for operator training

Potential Shock Hazards

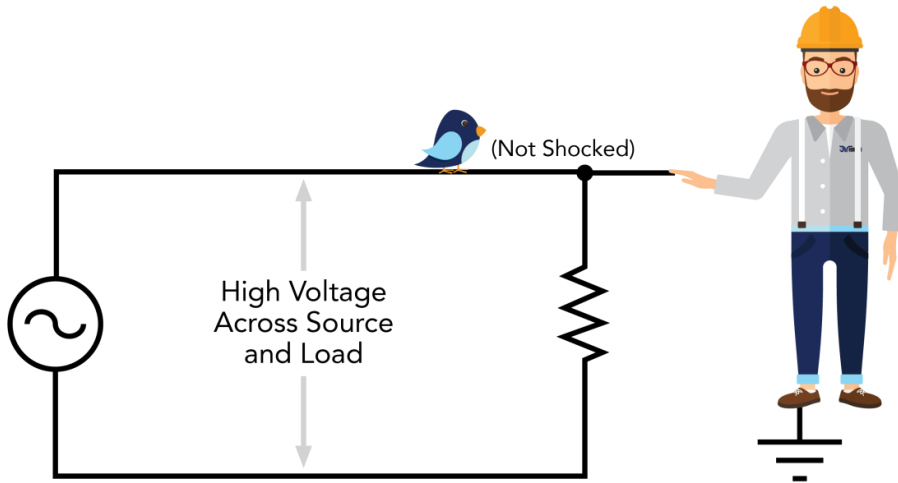


Contact with the "High" side of Voltage while standing on ground allows a path for current to return to ground through the Operator

Contact with the "Low" side of Voltage places Operator at same Potential as ground therefore there is no Potential difference or Voltage to allow current to flow through him.

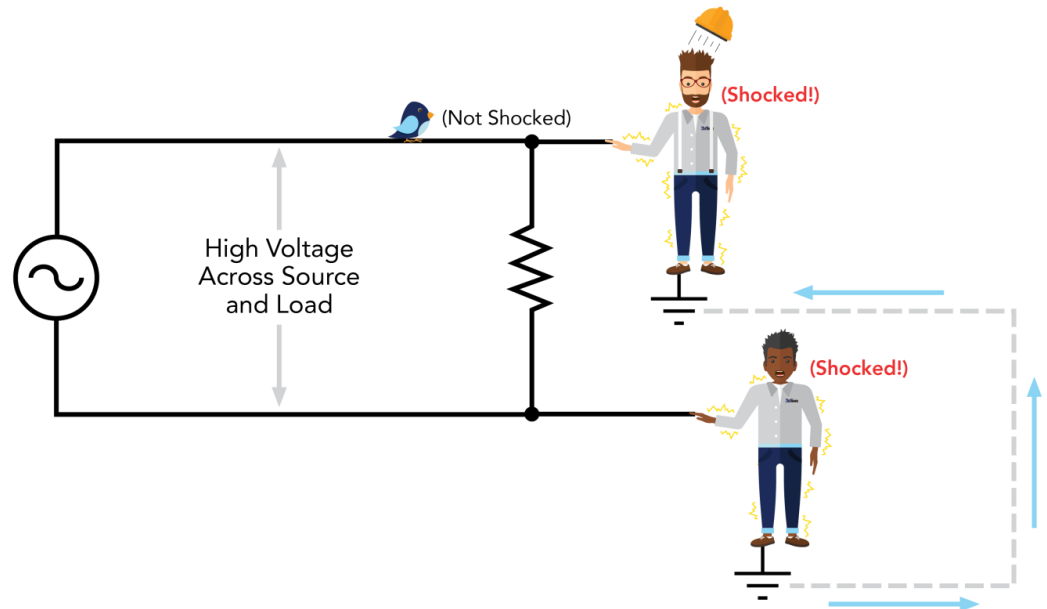


(Not Shocked)



An isolated source in theory is safe. Since the low side of the transformer is not referenced to ground, making contact with any point of the circuit while standing on ground does not allow current a path back to the source.

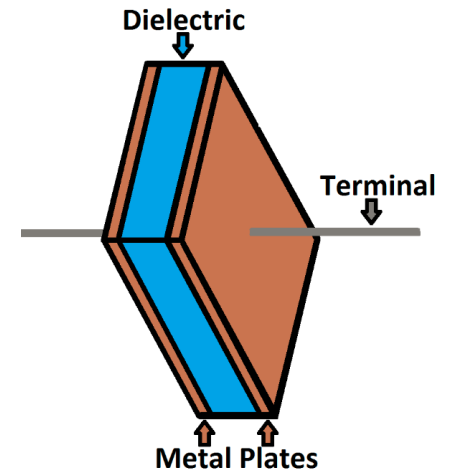
The danger with an un-grounded power source is the possibility of accidental grounding or contact made with two points of the circuit.



Dangers of Capacitive Charge

Capacitors consist of conducting surfaces separated dielectric (insulator). The effect of this is that when a voltage is applied, charge flows into the capacitor and is stored. When an external circuit is connected to the capacitor, this stored charge will flow from the capacitor into the circuit.

- Cap's react against a change in voltage by either supplying current (discharging) or drawing current (charging).
- During an AC Hipot test a capacitive DUT alternates between charging and discharging but during a DC hipot test charge will remain if not ramp down or discharge is accounted for.



Unintended capacitors can cause potential shock hazards



Effects of Electrical Current on the Human Body

<u>Current</u>	<u>Reaction*</u>
0.5 to 1 milliamp	Perception
5 milliamps	Slight shock felt, startled reaction
6 to 30 milliamps	Painful shock and inability to let go
30 to 150 milliamps	Extremely painful, respiratory arrest, ventricular fibrillation, death possible
10 amps	Cardiac arrest, severe burns

*These effects are for voltages less than 600 volts. Many electrical safety testers can output voltages in excess of 5000 volts which can cause more severe reactions at lower current levels

The effects of current can vary drastically due to a number of variables. It's important to be mindful to the shock hazards to which you could be exposed. For example, the 3705 hipot tester has the capability to output 20mA of AC current.

Severity of Electrical Shock

The severity of shock is received by a person who contacts an electrical circuit is influenced by several factors:

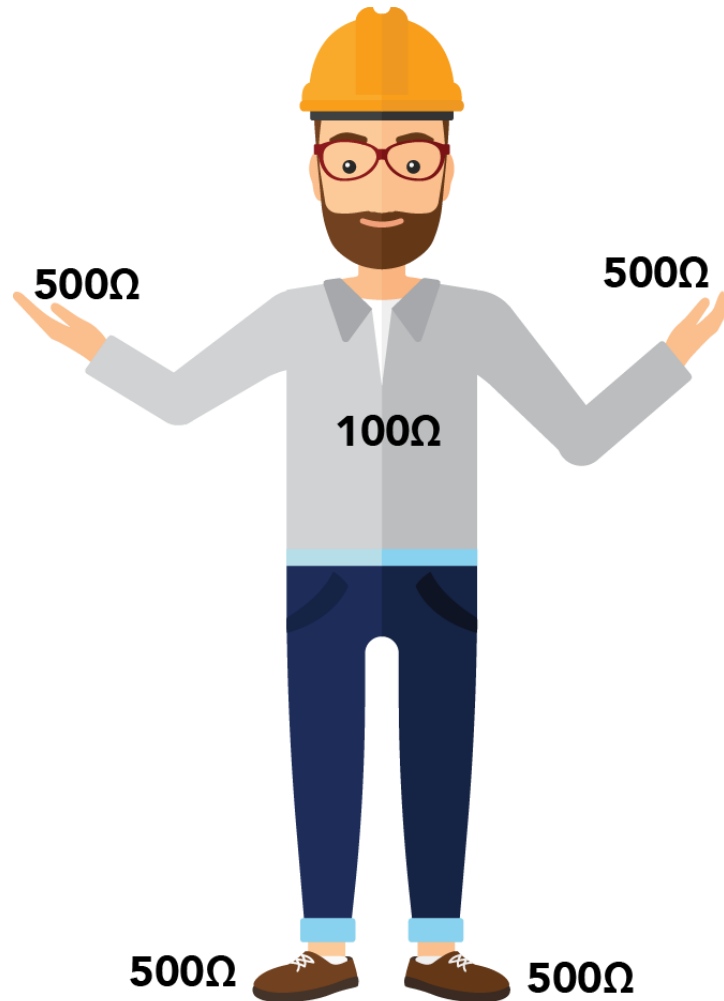
- The frequency of the supply voltage.
- The duration or length of time the person is exposed.
- Physical condition and response.
- The magnitude of the voltage and current flow.
- The path of the electrical current through the body.

4 Main types of Electrical injuries:

Electrocution (fatal) • Electric shock • Burns

Falls caused as a result of contact with electrical energy

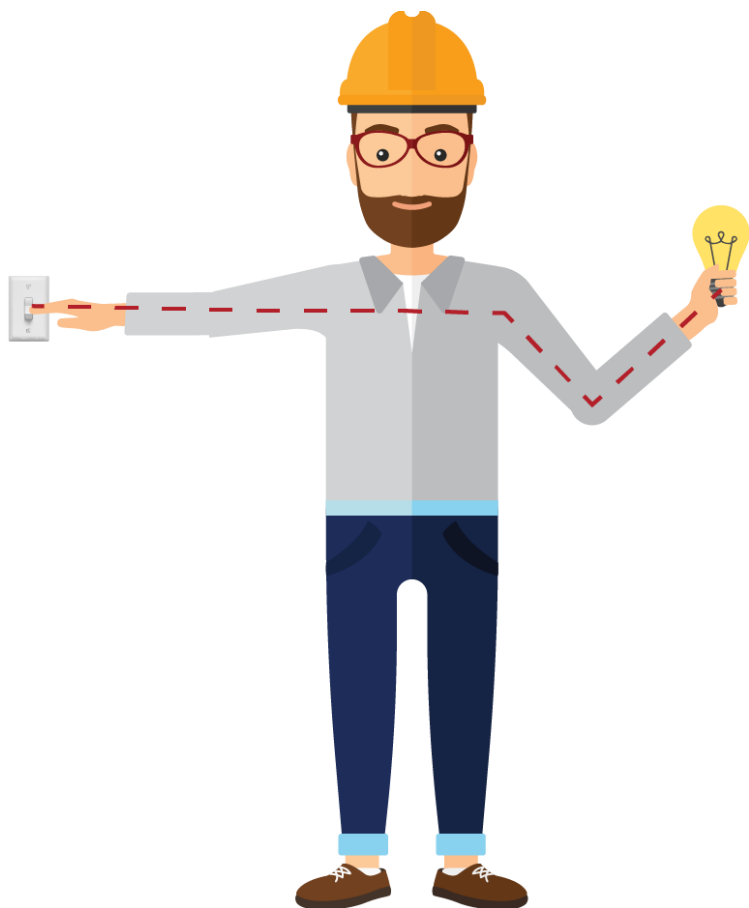
Human Body Resistance



The human body on an average has about 1000 to 1500 ohms resistance.

The outer layer of the skin provides the largest percentage of the body's electrical resistance.

The parts of the body which conduct the electricity the best are the blood vessels and nerves.



The current required to light a 7 watt, 120V lamp, passed across the chest is enough to cause fatality.

$$I = 120V / 1,000 \text{ Ohms} = 0.120A$$

Why Test?

There are four main reasons why you should safety test your products prior to shipment

1. Safety	Ensure that the product is not going to pose a hazard to the end user.
2. Quality	Detect workmanship defects and prevent faulty components from being installed.
3. Cost Control	Identify production problems before a product is shipped, preventing costly recalls.
4. Liability	Prevent product liability suits because the responsibility of performing electrical safety tests ultimately rests on the manufacturer

Testing also comes down to risk analysis. Safety standards call for production hipot and continuity testing. However, there has been a shift in recent years towards more stringent production line testing.

Testing Laboratories

Implement and enforce electrical safety testing to protect users from potential electric shock.

Create standards that outline performance and production testing.



NRTL Examples Underwriters Laboratories (UL – United States), TÜV Rheinland (Germany), Canadian Standards Association (CSA – Canada), ETL (Intertek – United States) and CCC (China Compulsory Certification – China)

Poll Question

Which lab do you certify with?

UL – ETL – TUV

NRTL standards dictate that electrical products incorporate two lines of defense to protect the user from electrical shock

Insulation

- Separates power lines from low voltage circuits.
- Separates power lines from isolated power supplies.
- Isolates input power from the chassis or case of an electrical device.

Safety Grounds

- Allow dangerous fault currents to return to system ground.
- Enables circuit breakers to open.
- Safeguards against fire.
- Protects against damage to electrical equipment.

Electrical products can be classified according to insulation type

Class I Products



- Terminate in 3 prong line cord (line, neutral and ground).
- Ground prong connects to product chassis.
- Safety through basic insulation and proper grounding.

Class II Products



- Double insulated products.
- Terminate in 2 prong line cord (line and neutral).
- Safety through dual layer of insulation.

Electrical Accidents in the Workplace

Most electrical accidents in the workplace are a direct result from one of the following three factors:

1.

Unsafe equipment or installation

2.

Unsafe Environment

3.

Unsafe Work Practices

These accidents can be prevented through the use of insulation, guarding, grounding, electrical protective devices and safe work practices.

How to Create a Safe Work Area

Operator Training

- Understanding Voltage and Current
- Identifying potential shock hazards

Utilizing Safety Devices

- DUT Enclosures, Signal Tower lights, Insulation Mats, etc.

It's the responsibility of the employer to ensure safe working conditions and safe working environments for all test operators.



How to Create a Safe Work Station



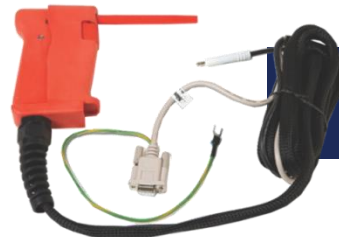
Enclosure designed to remove shock hazard



Use PPE (Personal Protective Equipment)



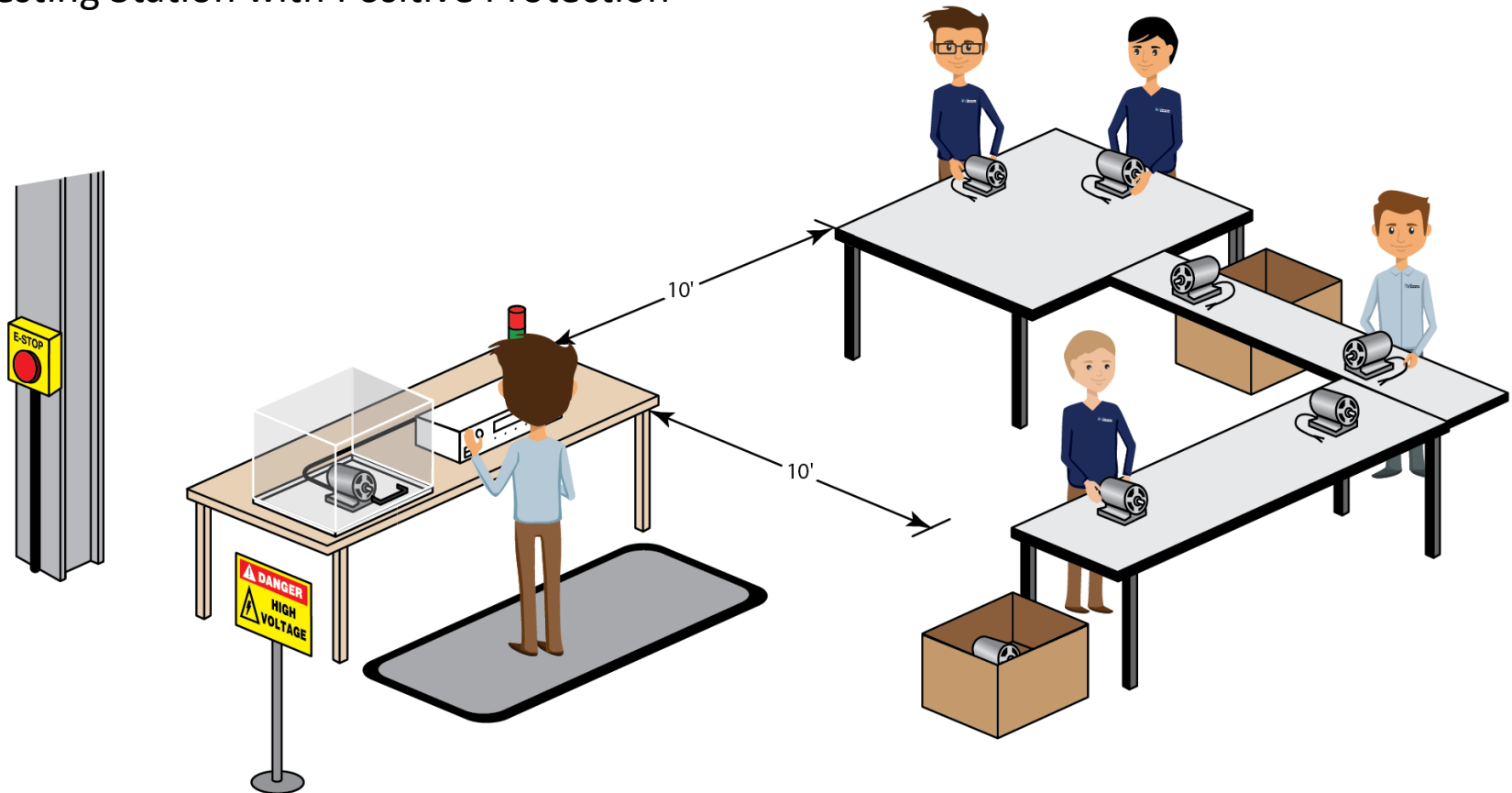
Be aware of all nearby hazards



Cabling and insulation

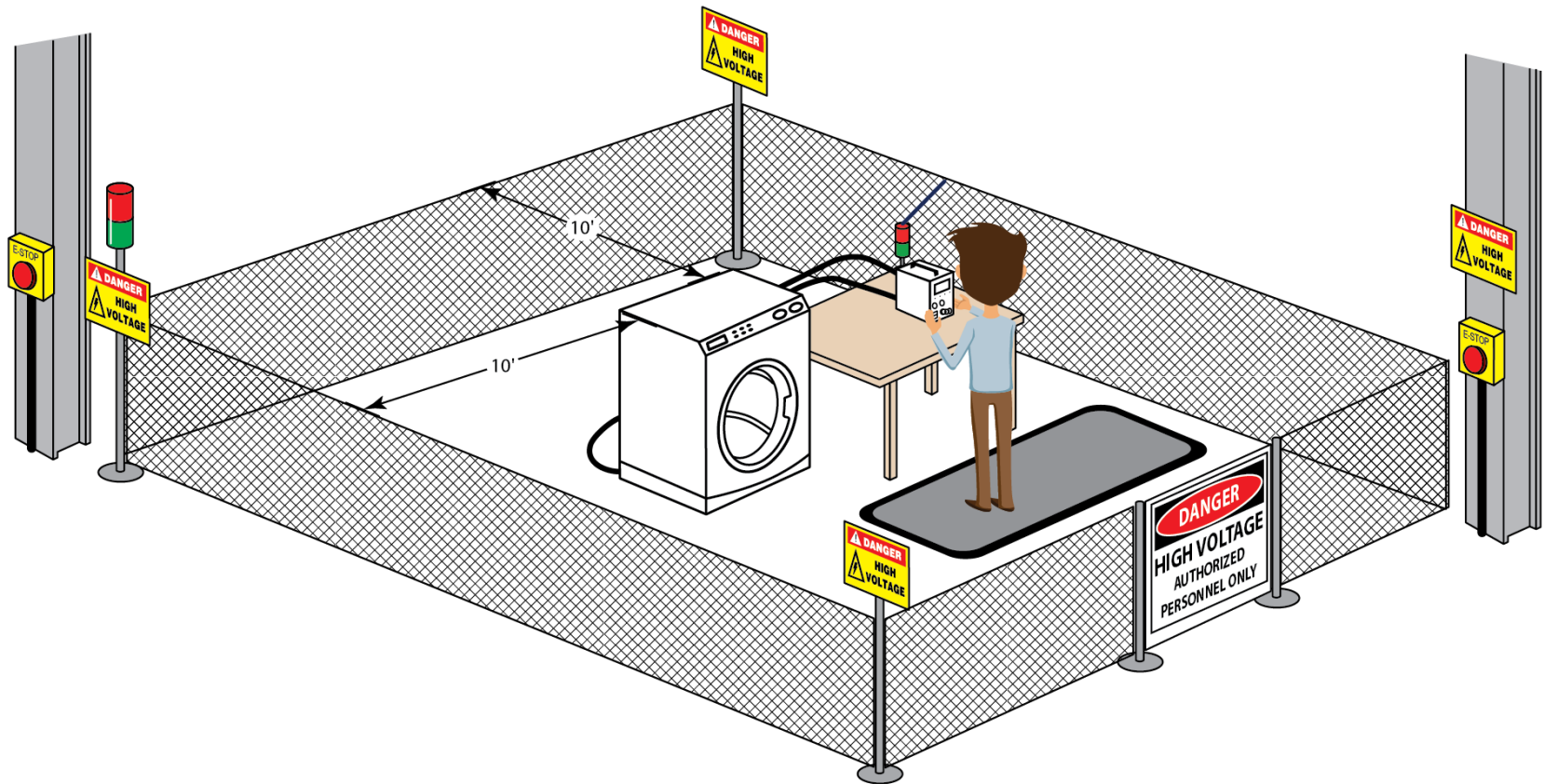
Methods of Safety Testing

Testing Station with Positive Protection



Methods of Safety Testing

Testing Station with NO Positive Protection



Additional Methods for Operator Safety



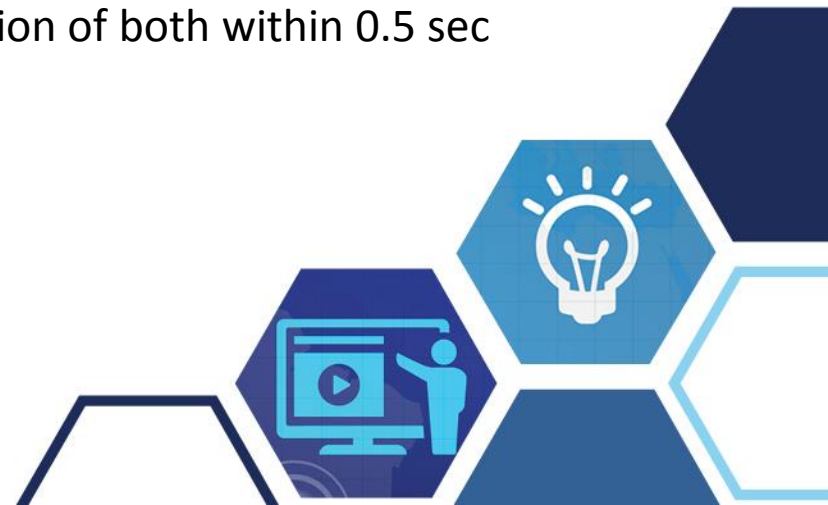
SAFETY FIRST!

This does not allow the operator to touch the DUT as their hands must remain on the test switches during the test.

Dual Palm Remote Switches

Simultaneous Activation

Activation of both within 0.5 sec



Additional Methods for Operator Safety



SAFETY FIRST!

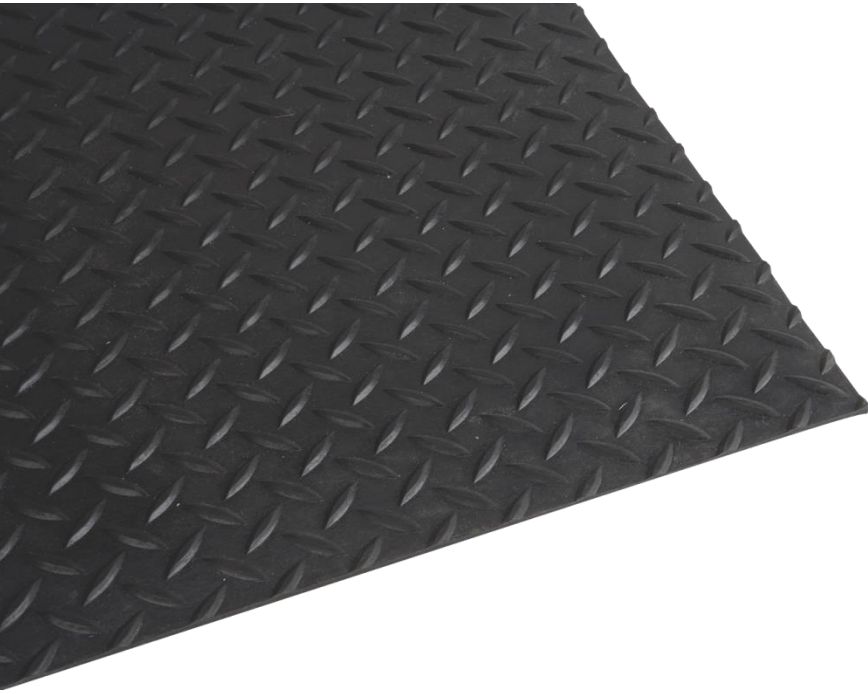
Mounted lights warn operators in the nearby area to the status of the Hipot test and if the instrument is outputting high voltage.

Signal Lights

Illuminates red when test is active.
Mounted in plain site for entire work area.



Additional Methods for Operator Safety



SAFETY FIRST!

The mat isolates the operator from ground while testing which greatly mitigates the shock hazard.

Insulation Mat

Isolates user from ground potential



The background features a dark blue world map with a hexagonal grid overlay. Various icons are placed within the hexagons, including a stopwatch, a lightbulb, a graduation cap, a question mark, a microphone, a laptop, a smartphone, and a person at a computer. The words 'ONLINE SEMINAR' and 'WEBINAR' are also visible within some hexagons. Circuit-like lines are drawn across the bottom of the image.

Poll Question

What safeguards are you currently using in your workstation?

Training Resources



OSHA 29 CFR part 1910.332 Subpart S

- Defines the training requirements for anyone exposed to voltages in excess of 50 volts
- Employees must be qualified to work on or near exposed energized parts



NFPA 70E: Standard for Electrical Safety in the Workplace 2012

- Explains reason behind the rule and how to comply
- Safe work practices, PPE and lockout/tagout procedures



BS EN 5019: 2010

- Erection and Operation of Electrical Test Equipment
- Defines recommended setups for electrical testing stations



Educational Resources

Visit us online to view all of our Educational Resources
[arisafety.com/support/educational-resources/](https://www.arisafety.com/support/educational-resources/)



Contact Us

If you would like a copy of this presentation please email Brittany Socha at brittany.socha@ikonixusa.com

Check out our website for more information arisafety.com

