



SAFETY

**IN FIELD METERING
EQUIPMENT**



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Today We're Going to Cover:

What can go wrong

How electricity damages the human body

Safety Standards

Personal Defenses

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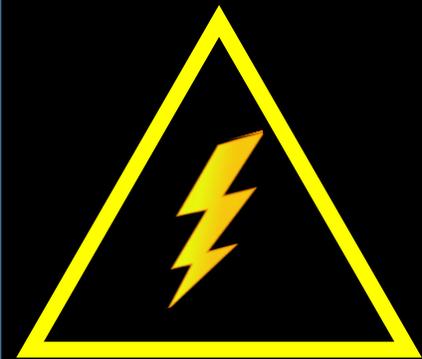
WARNING



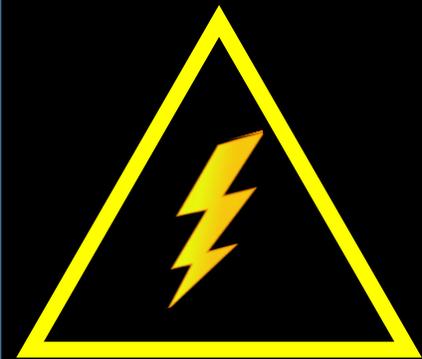
**Let's take a look at
what can happen...**

WARNING

Arc Flash



WARNING



Hot Stick Hazards



The BIG Question

**How do you stay safe
when you have a
dangerous job?**

THE

DAMAGE

ELECTRICITY

CAN CAUSE

DANGERS

Voltage

Current

$$V = I * R \rightarrow I = \frac{V}{R}$$



Condition	Dry	Wet
Finger Touch	40 kΩ – 1 MΩ	4-14 kΩ
Hand-holding Wire	10-50 kΩ	3-6 kΩ
Palm Touch	3-8 kΩ	1-2 kΩ
Human Body		200-1000 Ω

$$I = \frac{V}{R}$$



**Resistance of a hand
holding a wire (R) = ~ 10,000Ω**

Location	Voltage (V)	
Household Outlet	120V	$12mA = \frac{120}{10,000}$
Meter	120-480V	$48mA = \frac{480}{10,000}$
Electric Pole	7200V	$0.72A = \frac{7,200}{10,000}$
Substation	>100KV	$10A = \frac{100,000}{10,000}$

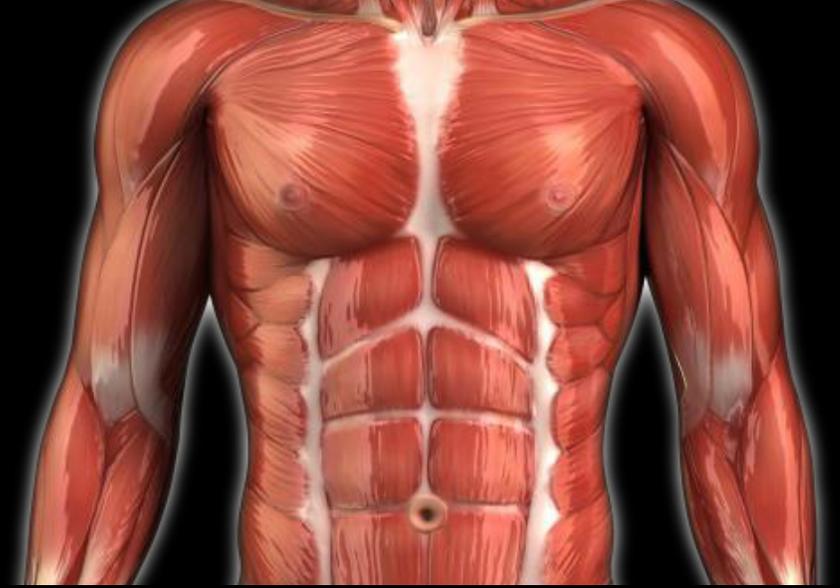
How Electricity Effects the Human Body

Muscle Control

Respiratory Paralysis

Heart Fibrillation

Tissue Burns



3-10 mAmps

Loss of muscle control

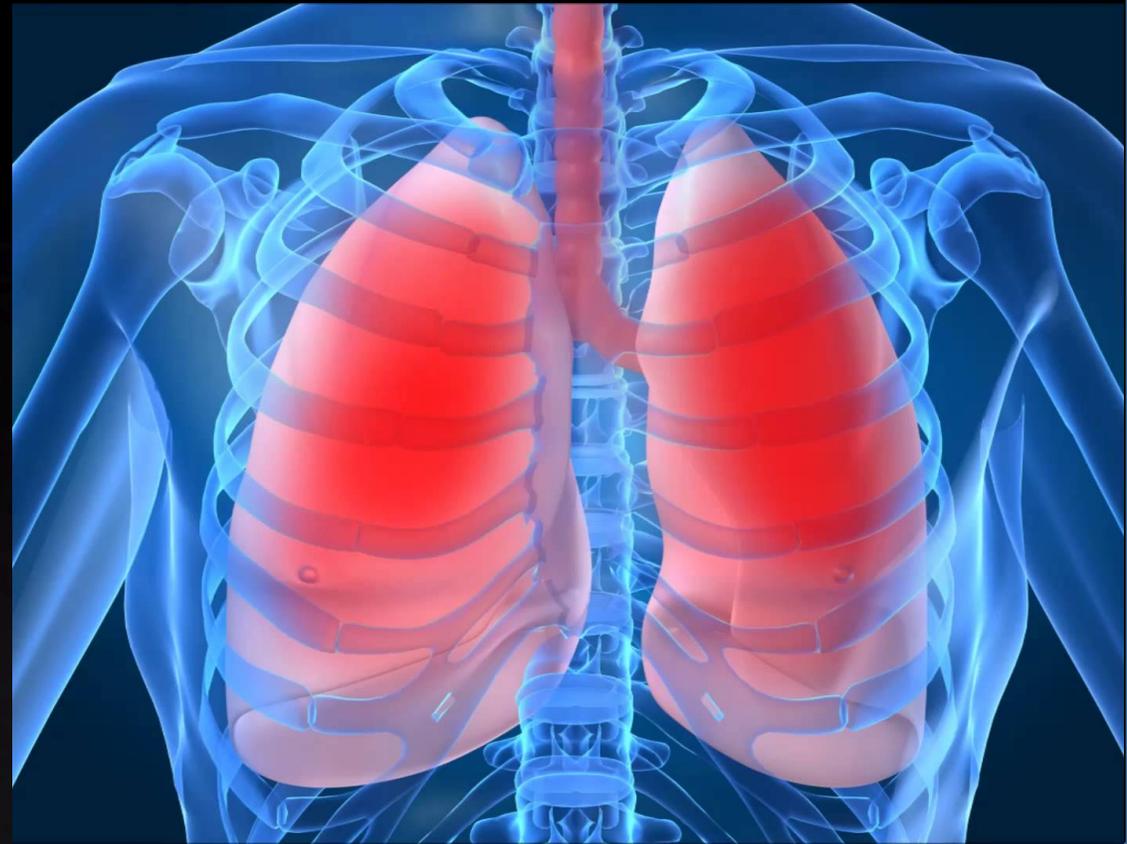
Household Outlet = 12mAmps

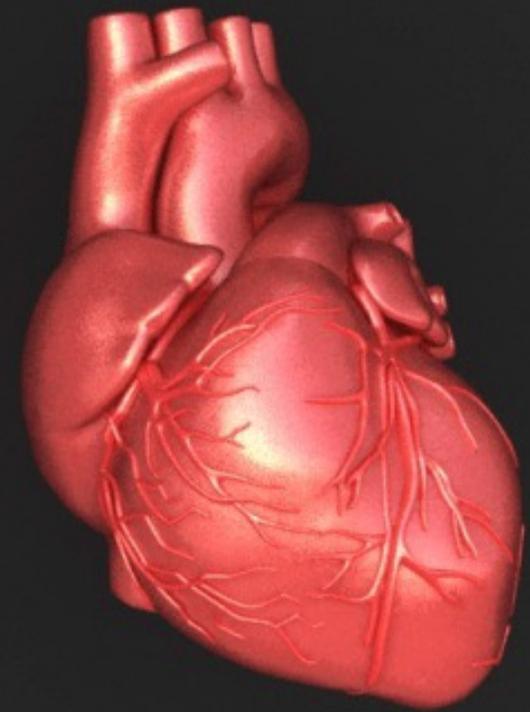


30-75 mAmps

**Respiratory
Paralysis**

Meter Site = 48mA





**75 mAmps to
4 Amps**

Heart Fibrillation

Pole = 700mAmps



**More than
4 Amps**

Tissue Burns

Substation = 10+ Amps



IEC 61010

SAFETY STANDARDS

IEC 61010

Electric Shock

Mechanical Hazards

Fire

Mechanical Stress

Hazards from Fluids

Resistance to Heat

Protection Against Radiation



Protection Against Explosions

SAFETY STANDARDS

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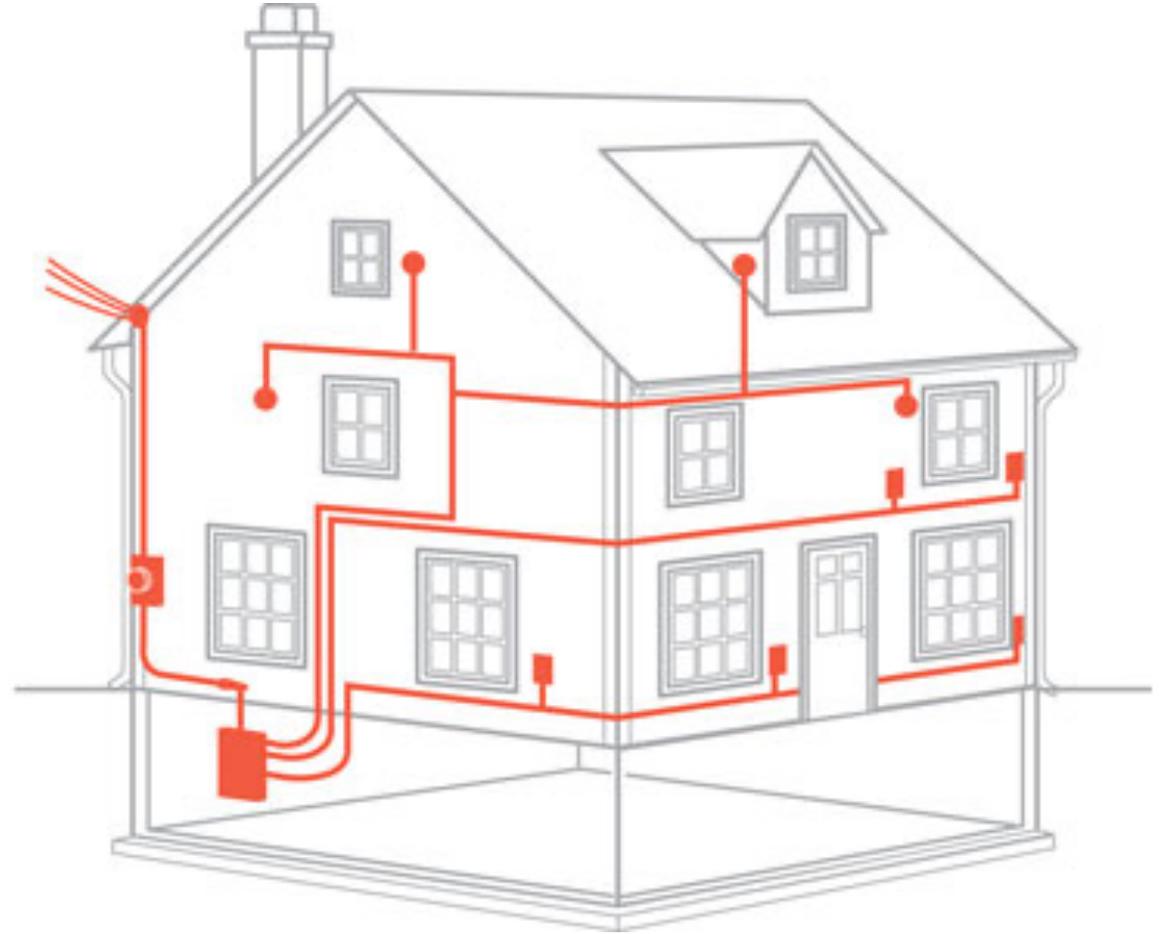
CAT II



SAFETY STANDARDS

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CAT III



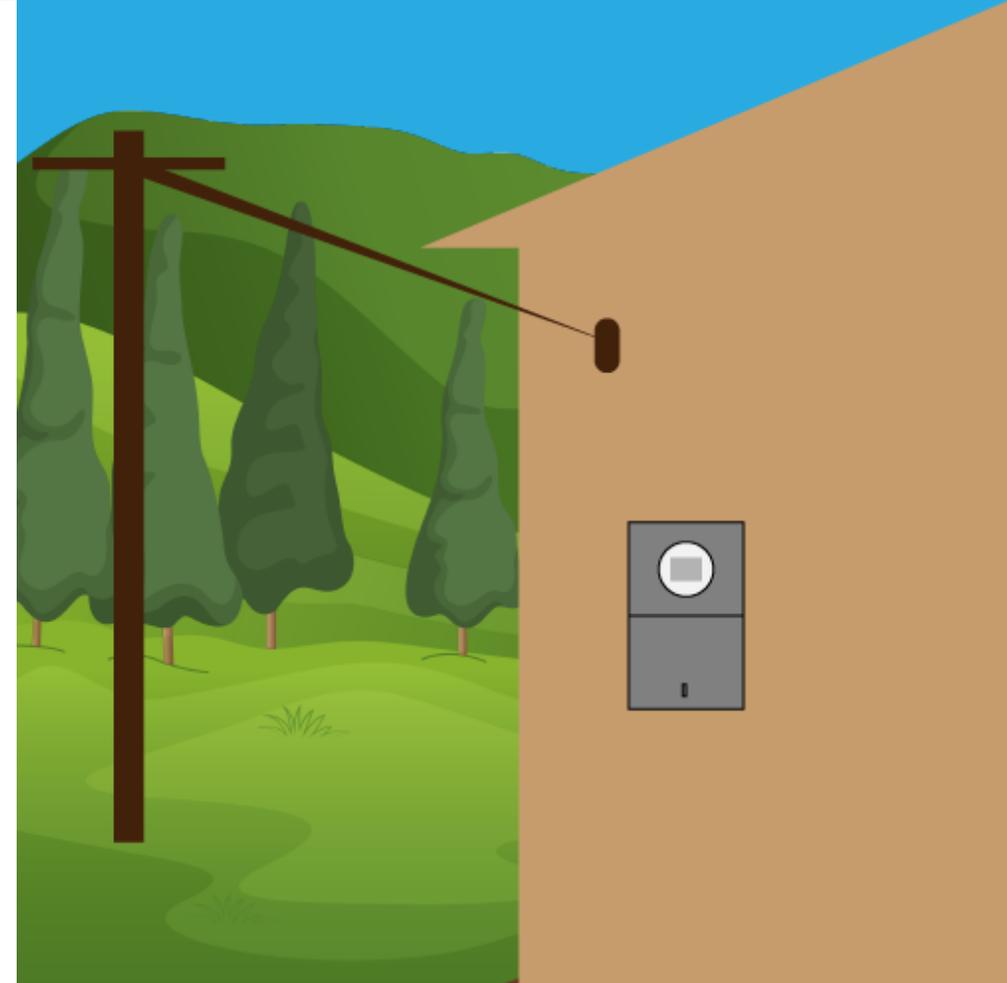
SAFETY STANDARDS

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CAT IV

Best rating possible:

600 Volts



SAFETY STANDARDS

Why are these ratings important in metering safety?



IEC 61010

CAT IV

Where does all that electricity go?

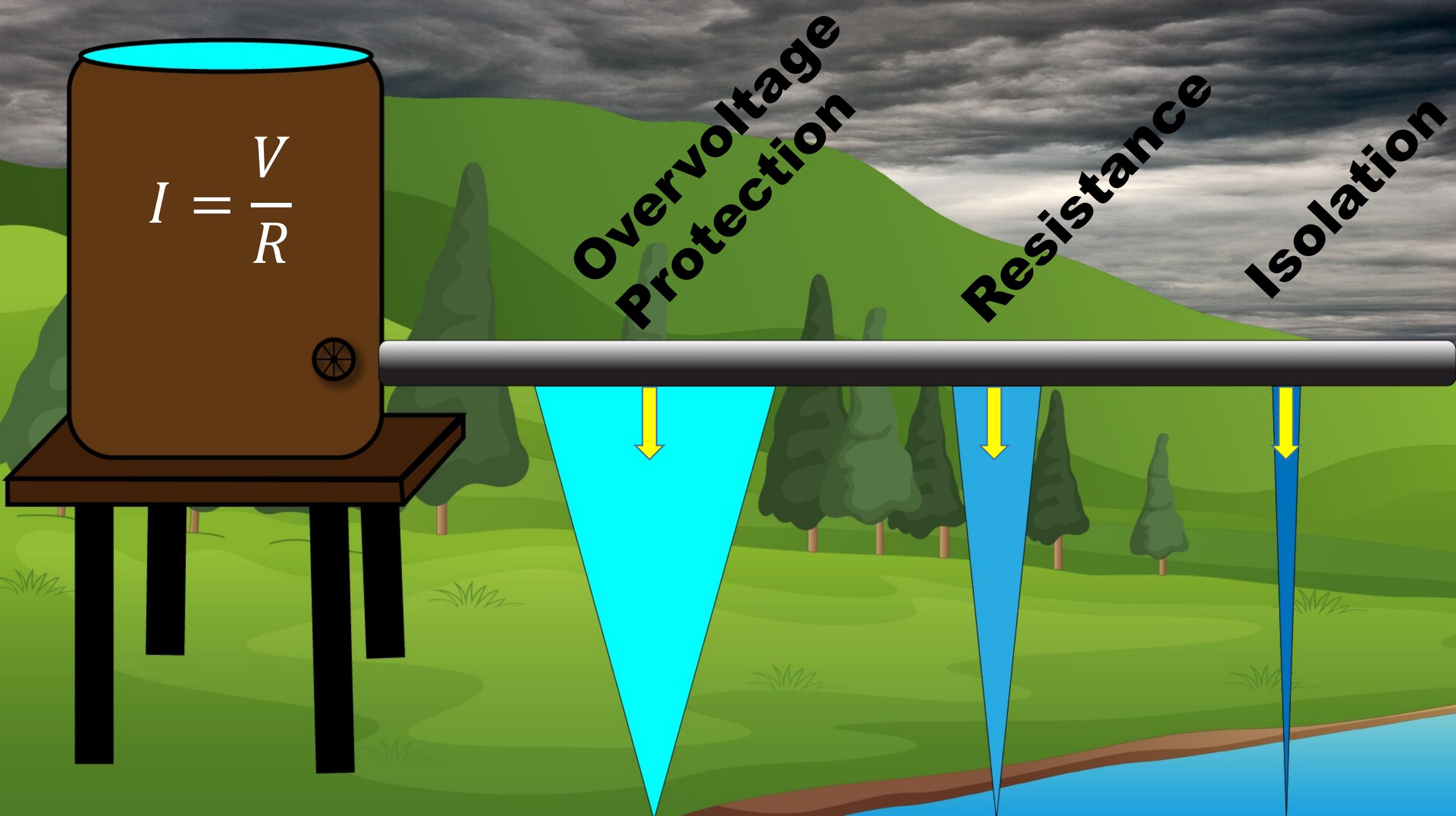
SAFETY STANDARDS

$$I = \frac{V}{R}$$

**Overvoltage
Protection**

Resistance

Isolation



Personal Protective Equipment (PPE)



PPE

ASTM Labeling Chart Natural Rubber Electrical Insulating Gloves			
Class Color	Proof Test Voltage AC/DC	Max. Use Voltage AC/DC	Insulating Rubber Glove Label
00 Beige	2,500 / 10,000	500 / 750	10 ASTM D120 CLASS 00 TYPE I MAX USE VOLT 500V AC EN60903 TYPE I 500V AC
0 Red	5,000 / 20,000	1,000 / 1,500	10 ASTM D120 CLASS 0 TYPE I MAX USE VOLT 1000V AC EN60903 TYPE I 1000V AC
1 White	10,000 / 40,000	7,500 / 11,250	10 ASTM D120 CLASS 1 TYPE I MAX USE VOLT 7500V AC EN60903 TYPE I 7500V AC
2 Yellow	20,000 / 50,000	17,000 / 25,500	10 ASTM D120 CLASS 2 TYPE I MAX USE VOLT 17000V AC EN60903 TYPE I 17000V AC
3 Green	30,000 / 60,000	26,500 / 39,750	10 ASTM D120 CLASS 3 TYPE I MAX USE VOLT 26500V AC EN60903 TYPE I 26500V AC
4 Orange	40,000 / 70,000	36,000 / 54,000	10 ASTM D120 CLASS 4 TYPE I MAX USE VOLT 36000V AC EN60903 TYPE I 36000V AC



PPE

Safety Glasses

The ANSI Z87.1 standard requires a 1/4" steel ball to be impacted at a velocity of 102 mph without any breakage.



PPE

Hard Hat

The ANSI Z89.1 Type E or G. “E” is rated for 20,000 V (phase to ground) and “G” is rated to 2200V (phase to ground). Class C does not offer good electrical protection.



PPE

Boots

ASTM F2413-05, rated for electrical hazard “EH”
These are designed to impede the flow of electricity through the shoe and ground, thereby reducing the likelihood of electrocution.



PPE

Clothing

NFPA 70E, NFPA 2112
“FR” (flame resistant)
rating and “arc flash”
rating - Designed to
not catch fire if an
arc flash occurs.



PPE



SPECIFIC HAZARDS IN METER TESTING APPLICATIONS

What is it?

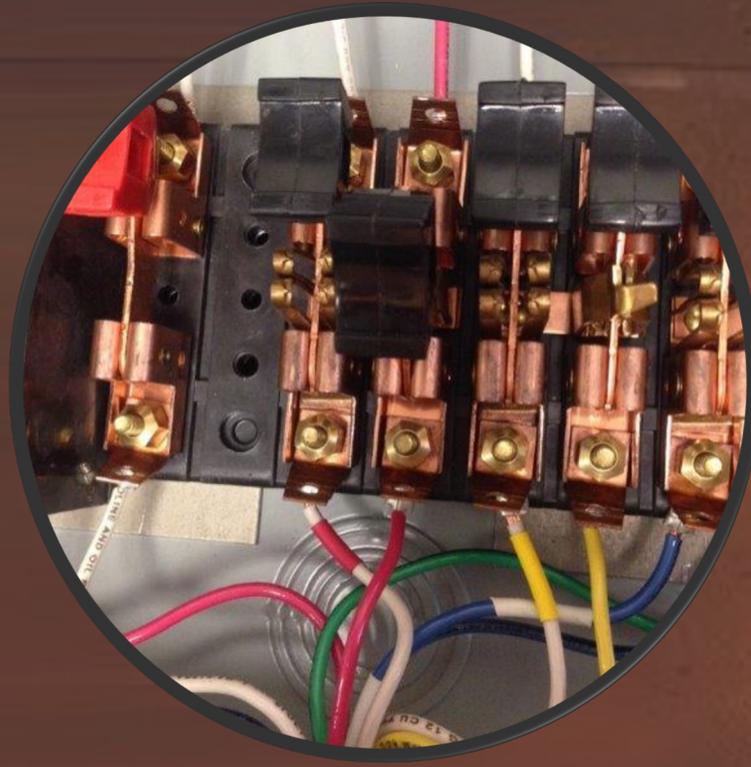


ARC FLASH

A phenomenon where a flashover of electric current leaves its intended path and travels through the air from one conductor to another, or to ground.



ARC FLASH





HOT STICK HAZARDS

When do meter technicians use hotsticks?



**When using
high-voltage:**

**CURRENT
PROBES**

**VOLTAGE
PROBES**

WHY THEY WORK



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Thank you for your time!

