

# Handheld Test Tool Safety



How not to save time...



Last known earthly residence of automotive fuse used to replace original fuse

Test leads survived intact

# Handheld Test Tool Safety



The wrong meter to use on a power circuit.

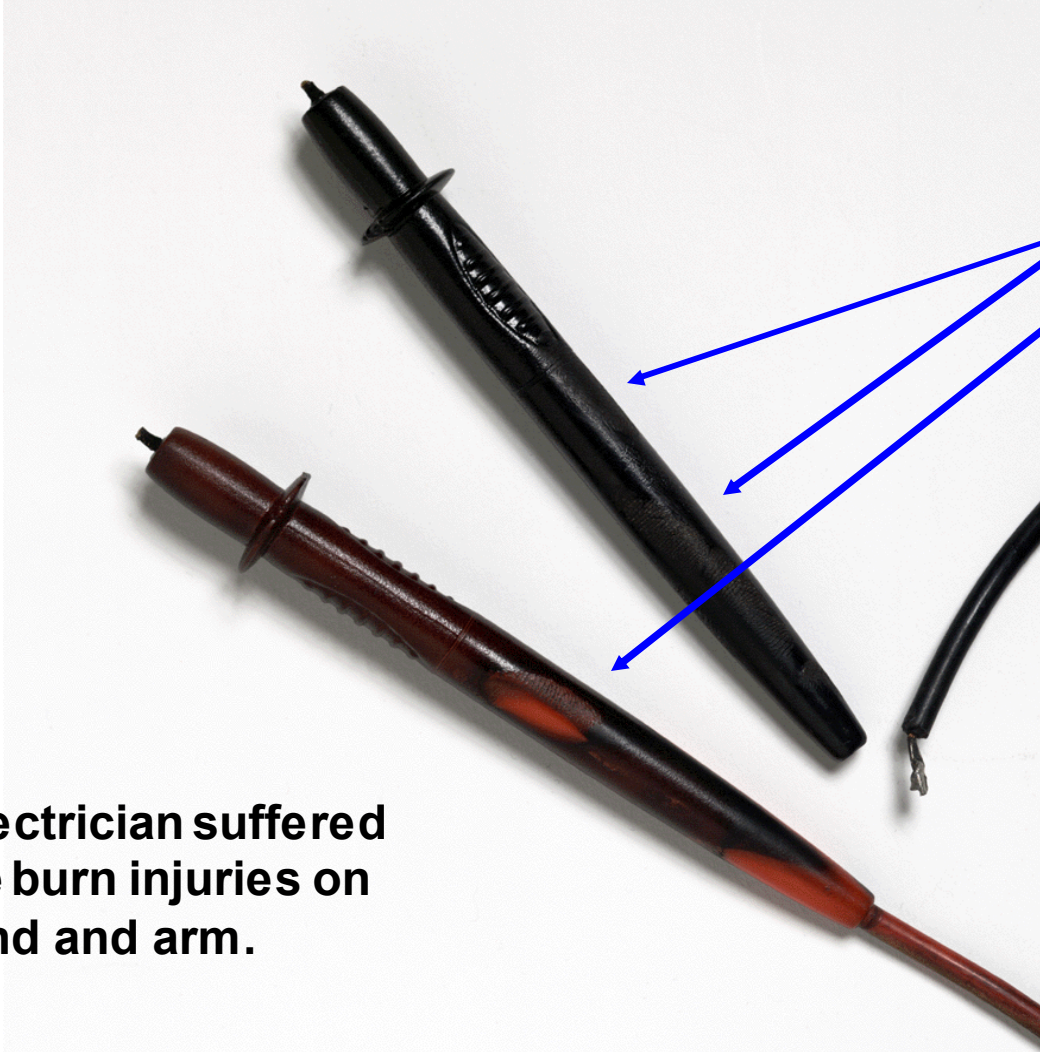


250V fuse didn't open in time

Probe tips burned off

Poor quality leads and probes led to injury.

# Handheld Test Tool Safety



**Fingerprints  
burned into  
probes**

**The electrician suffered  
severe burn injuries on  
his hand and arm.**

# Protection devices provide additional safety



**Fluke incorporates specially designed “high-energy” fuses in our digital multimeters**

Designed to keep the energy generated by an electrical short within the fuse enclosure

- Limit the amount of time current is applied and oxygen available for combustion
- In addition to the specially designed fuse element, the high energy fuse is filled with sand

High temperatures (up to 10,000°F) generated by the energy will melt the sand and turn it into glass, smothering the fireball by cutting off the available oxygen



# Common DMM safety hazards

## *Three common errors that are avoidable*

- **Measuring voltage while test leads are in the current jacks: *short-circuit!***

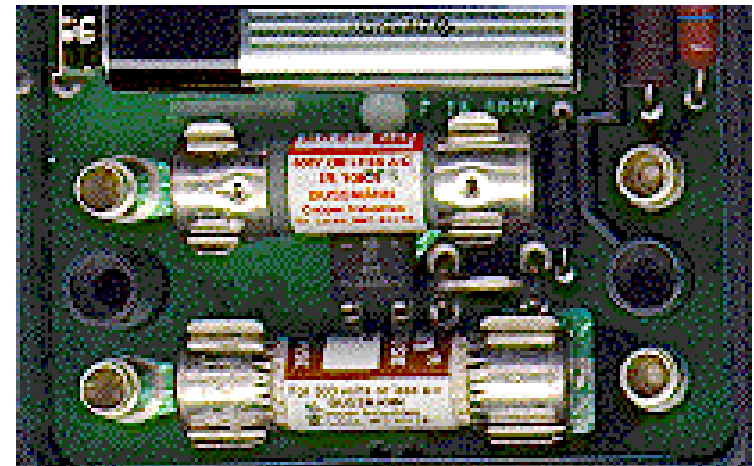
**Protection: Fluke meters use high energy fuses.**

- **Contact with ac or dc power source while in Ohms mode.**

Protection: Fluke meters have “Overload Protection”.

Functions are self-protected to the meter’s rated voltage.

- **Using meter above rated voltage, i.e., on medium voltage circuits.**
  - No Protection above rated voltages

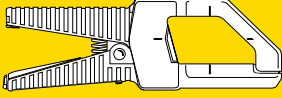
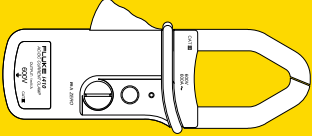


# How DMMs Measure Current

## *Current Clamp Accessories*



- In power circuits, clamps are used to measure amps.
- Two types of clamps: AC or AC/DC

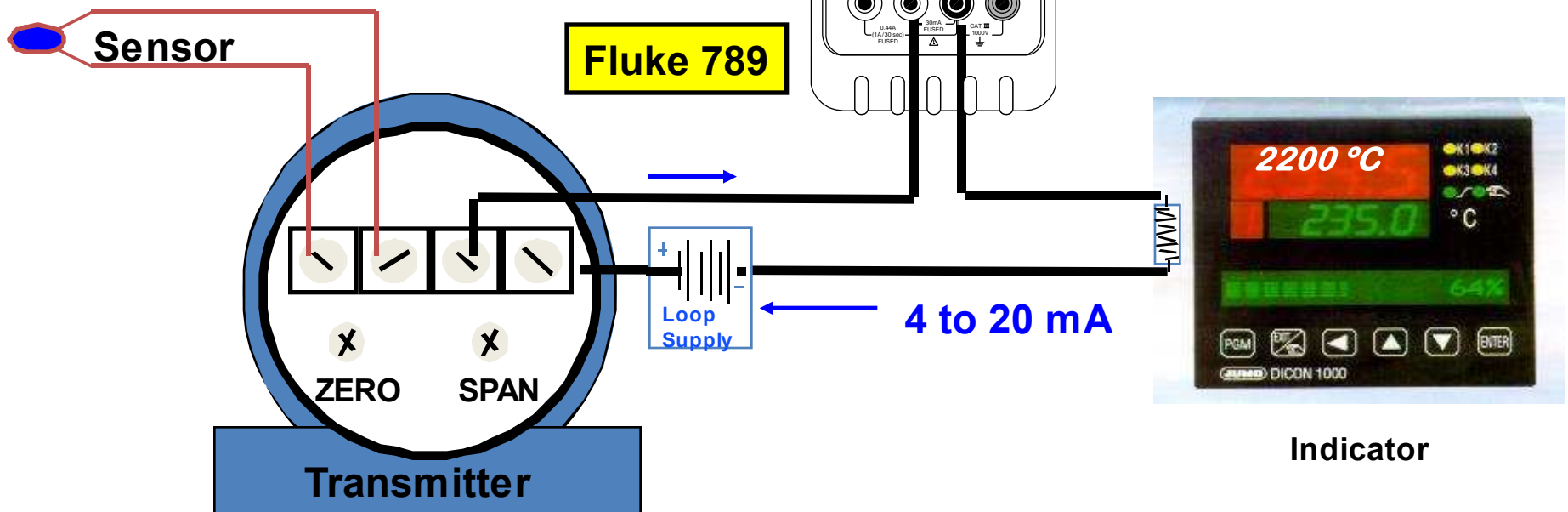
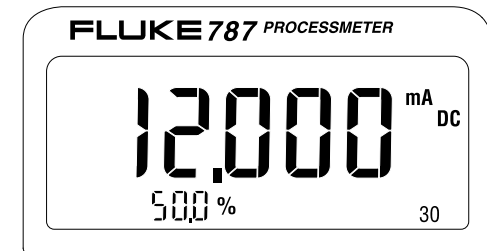
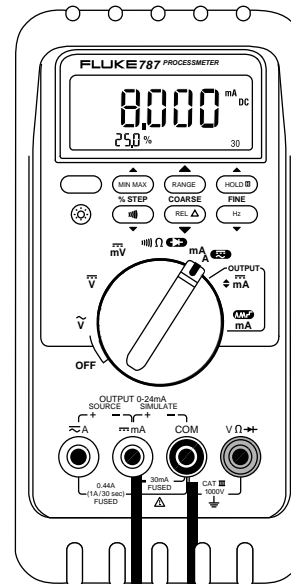
	<b>AC</b> Model: 80i-400 	<b>AC/DC</b> Model: i410, i1010 
<b>Output signal</b>	<b>Current</b>	<b>Voltage</b>
<b>Scale factor</b>	<i>1 milliAmp per Amp</i>	<i>1 milliVolt per Amp</i>
<b>Sensor</b>	<b>Current Transformer</b>	<b>Hall effect</b>
<b>Battery</b>	<b>No</b>	<b>Yes</b>

(Scope clamps have BNC connectors: AC or AC/DC both output mV. )

# Process Loops

## 4-20 mA process signals

- Very low current, in line measurement
- Measure transmitter o/p:
- Source 4-20 mA to indicator
- Simulate 4-20 mA



# Fluke 771 mA Process Clamp Meter



*Innovative new approach to measuring mA loop signals*

- Measure mA signals without breaking the loop
- Best in class mA measurement accuracy and resolution
- Save time and money troubleshooting PLC analog I/O and process loops
- Detachable clamp with extension cable
- Dual display with both mA and % of span readouts
- Measurement spotlight illuminates hard to see wires.
- Fluke 772 and Fluke 773 add full 4-20mA Source and Measurement for loop calibration and troubleshooting

***Measure 4-20 mA signals  
without breaking the loop.***

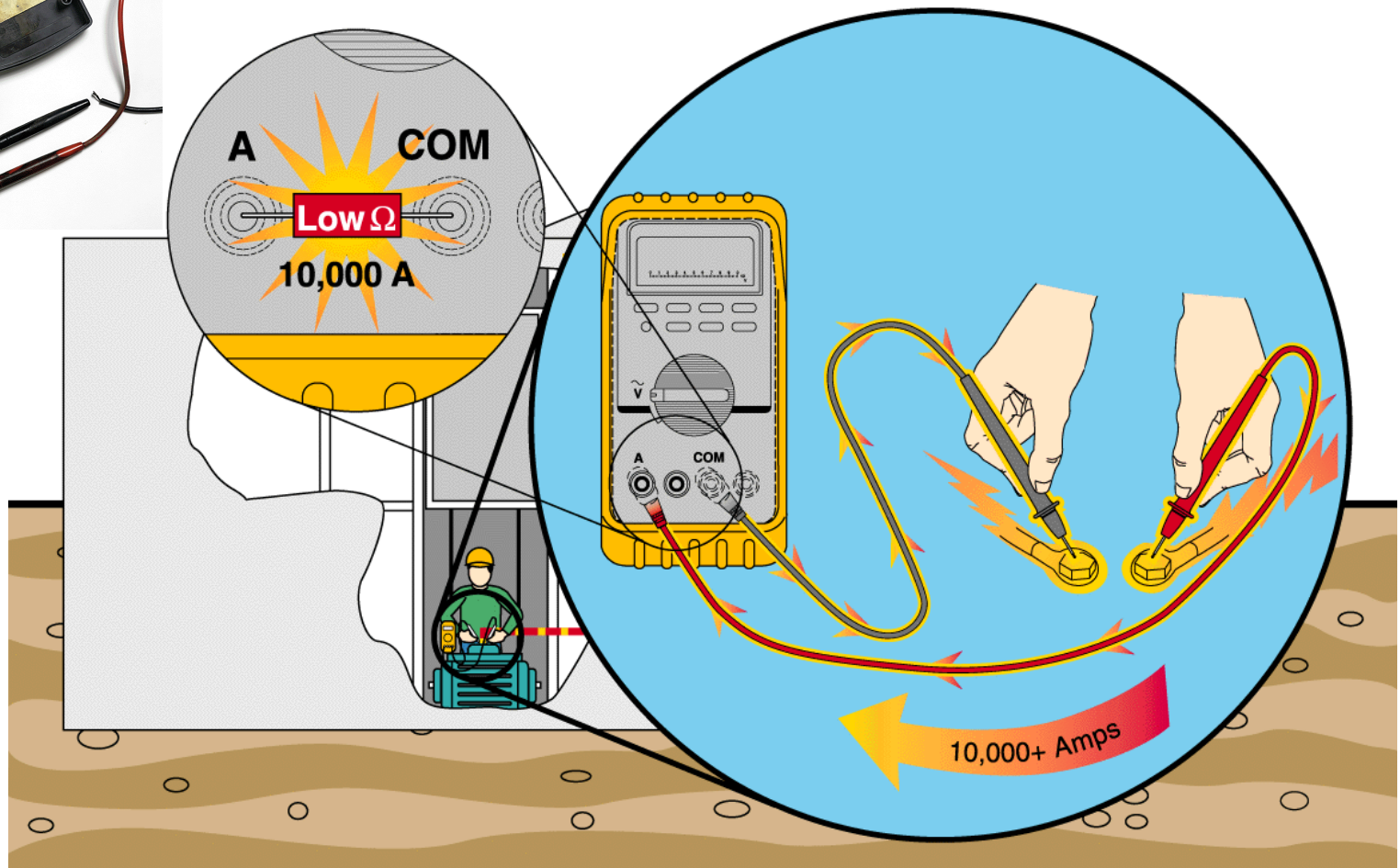
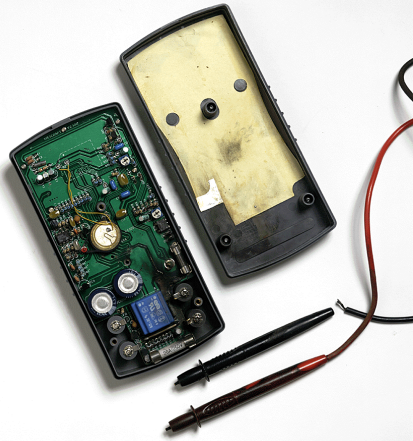




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# Misuse of DMM in Ammeter Mode

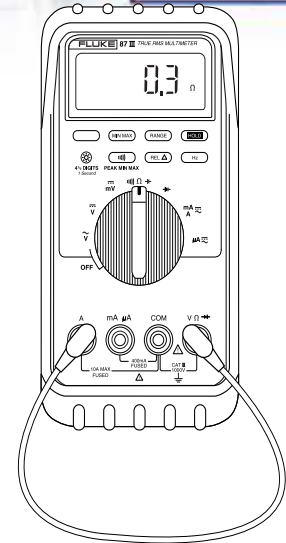


# Safety Inspection



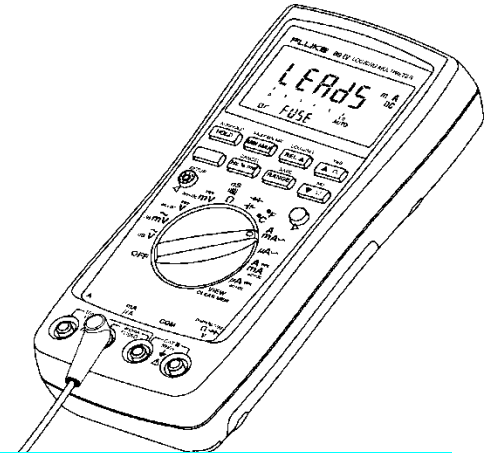
## Checking meter fuses on most meters

- Step 1: Plug test lead in V/  $\Omega$  input. Select  $\Omega$  .
- Step 2: Insert probe tip into mA input. Read value.
- Step 3: Insert probe tip into A input. Read value.
- Is the fuse okay? What would an open fuse read?



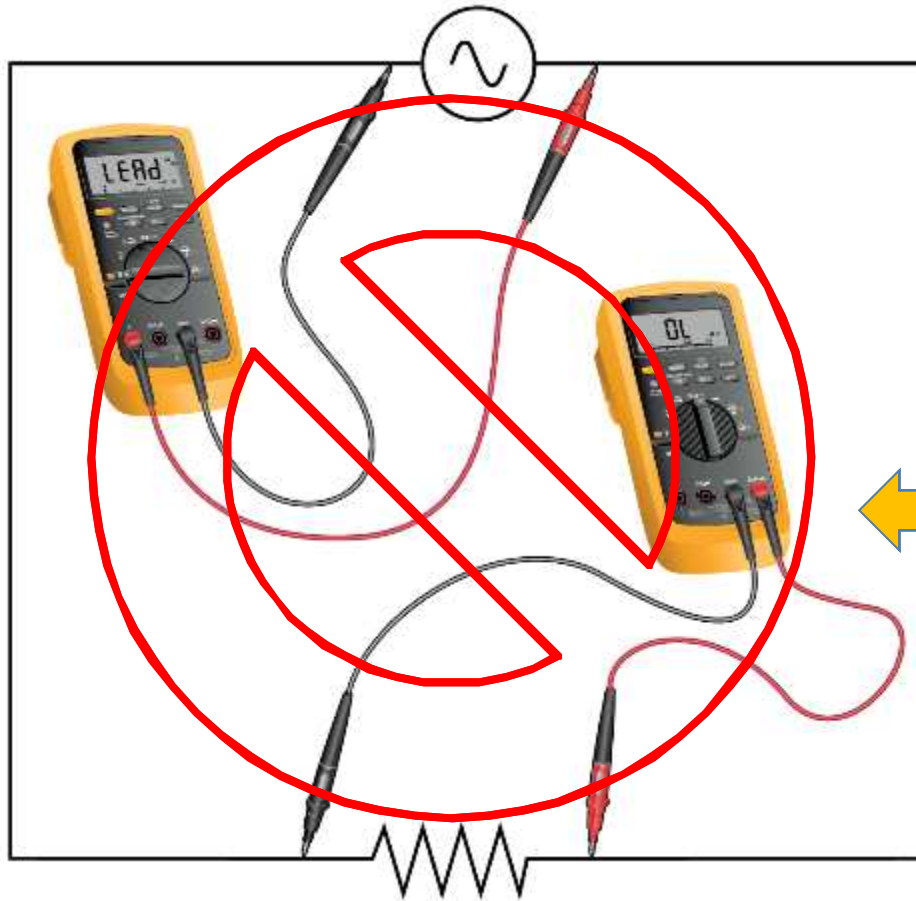
## Checking fuses on the Fluke 87-IV

- Step 1: Select **A**  
**mA**~ (w/o test leads).
- Step 2: Plug lead into mA and A input.
- Step 3: Listen for Beeps=fuse is good  
(special automatic warning circuit to prevent you from doing this)



Fluke 87: With lead in mA or A, select  $\Omega$  and listen

# Common **errors** with measurement tools



**Measuring ohms or continuity on a live circuit.**

Most older meters cannot handle the full voltage on the ohms function

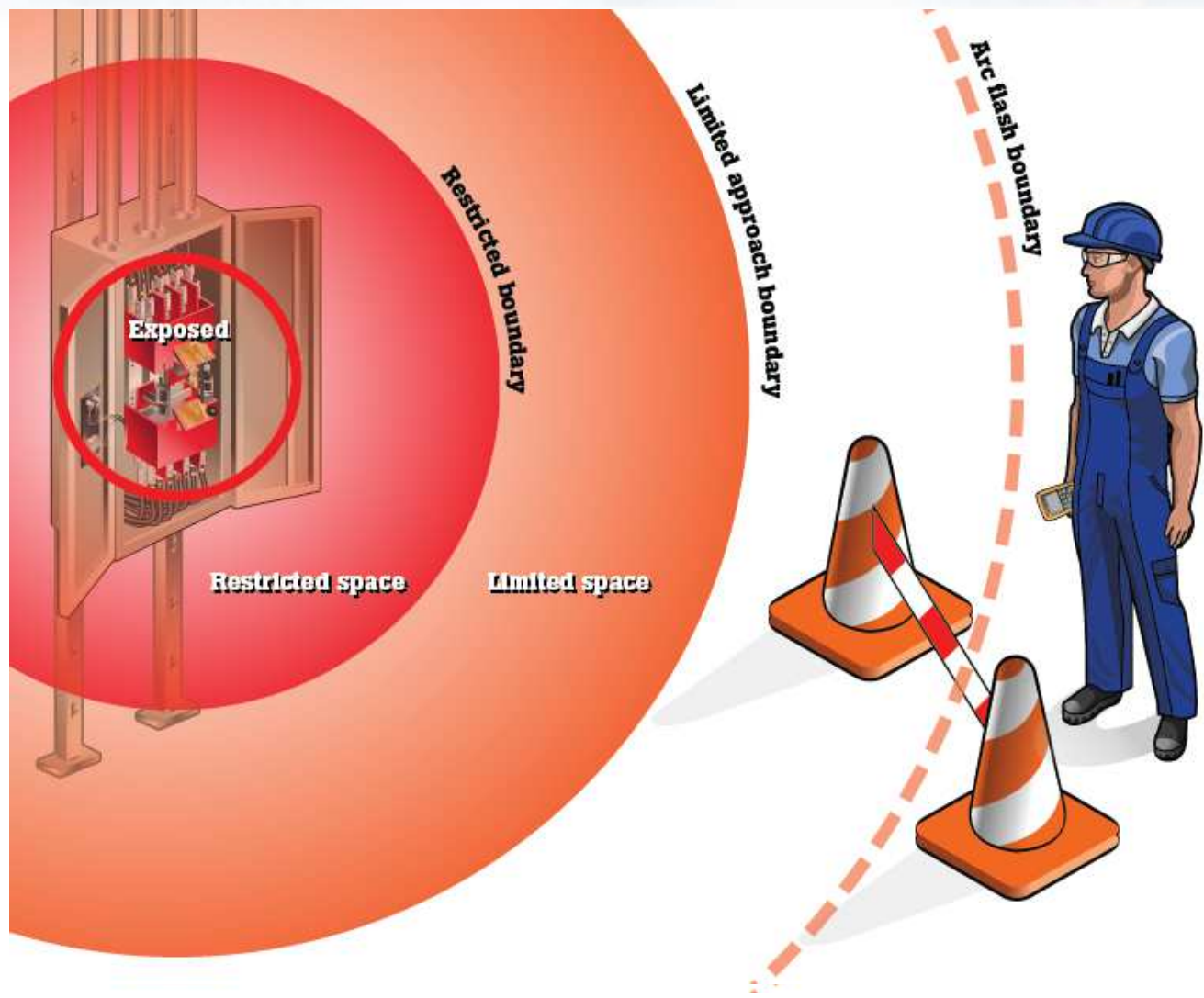
# PRESENTER SLIDE: PRACTICE and HIDE: Connecting Voltage while in the Ohms Demonstration



- Hold up Fluke 87 with leads plugged into Fluke 1587, 87=DC Volts; 1587 = Insulation Test mode
- “Part of the IEC 61010 Safety rating is if I have a 1000 volt meter, I should be able to connect 1000 volts in the volts terminals in any function, without anything happening to me or the meter.
- “Here I am applying 1000 volts to the input of this meter (Hold up 87-V with 1587 locked in 1000 mode output, walk around and show audience 1000V displayed on meter).
- I switch to ohms mode and apply the same 1000V. (show meter face “OL”) Those of you who have been around a while probably instinctively wanted to step back a little. Why? With older or unprotected meters, when you do this, if you are lucky you typically would see a puff of smoke and be in the market for a new meter. If you are unlucky, you’re holding a fire ball
- I’ll go back to volts, and see how the meter is still working fine? (Show 1000V on meter display)
- What I am using here is a mega-ohm meter, or insulation resistance tester. This pressure tests electrical wires, motor coils and such, to see if the insulation is going bad. Just as I would use water pressure to look for leaks on a hose, we use Electrical Pressure, or VOLTS, to pressureize the wire and look for leaks in the insulation. It is also a great way to test new wiring you just installed, instead of turning everything on and looking for smoke.
- Now while you have your meter with you at all times, chances are the megaohmmeter is back in the shop. What we’ve done is take the meter (show Fluke 87 in front) and the megger (show 1587 in front with other hand) and built them into one unit ( move and hold the Fluke 87 behind the Fluke 1587). This way you always have an insulation tester with you, and you are more likely to make these tests, instead of having to walk back to the shop.

# Safe working distances: Work Outside the Danger Zones

## Flash limits of approach



Boundaries apply when workers are exposed to energized electrical conductors or circuit parts.

# New Wireless measurement tools

## Provide physical separation in an arc flash environment



### One technician can do jobs that would otherwise require two people

Connect the meter or clamp to a conductor, remove the display and walk across the room to operate controls or remove protective equipment, all the while watching real-time readings.



# Enhance safety with wireless tools

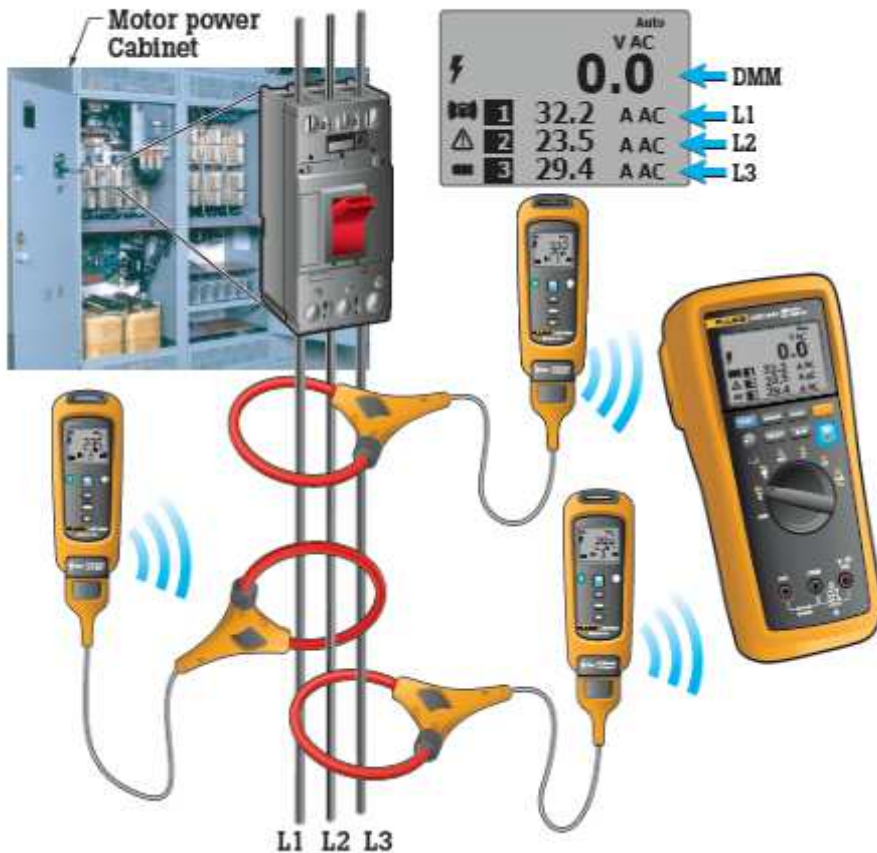
## Fluke Connect™ enabled tools for data transfer



# Fluke Connect Wireless Measurement Tools



## Determining current imbalance





# Fluke 1736/1738 Power/Energy Loggers

## Monitor, Record and Troubleshoot behind closed doors!



- Key Power Measurements
  - All measurements are measured and logged to eliminate the risk of not recording the important parameters.
- Fluke Connect App Compatible
  - Enables data to be viewed without having to suit up and can remotely view measurements – no need to visit panel
- Convenient Instrument Power
  - Powered from the measurement circuit means there's no need to find a power outlet and run power cord extensions



**Improves measurement efficiency, improves safety while measuring to get to answers more quickly and reliably**

# Fluke Connect Wireless Measurement Tools

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**SEE IT. SAVE IT.  
SHARE IT.**

Preventive maintenance simplified—  
Fluke Connect Assets.



# View multiple measurements simultaneously with Fluke Connect™ wireless tools



**View up to 10 live measurements simultaneously from energized equipment well outside of arc flash boundaries**

- 3-phase current and voltage
- Cause and effect relationships
- Log intermittent problems over time
- Verify lockout/tagout electrically safe status

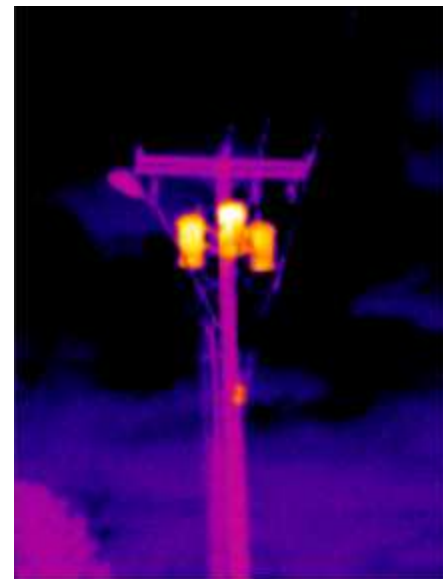
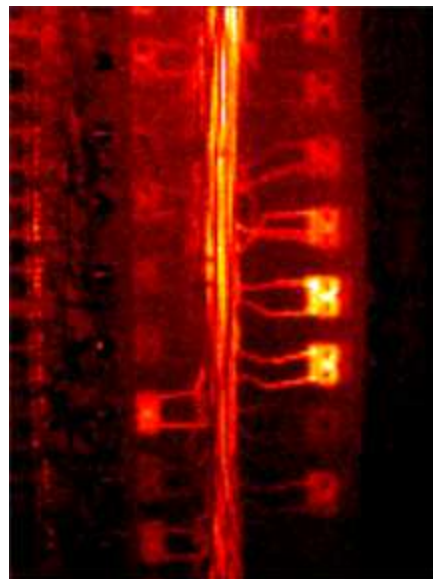
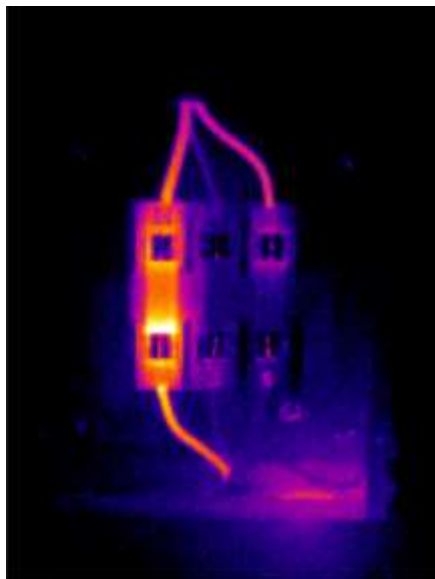
**Save all measurements wirelessly, for each piece of equipment, in one place, with the same one App for all testers.**

- Electrical measurements
- Temperature measurements
- Power and Energy usage
- Thermal Images
- Vibration

***Build your equipment maintenance database over time while doing your normal work!***



## The Safest Way to Measure Electricity is to Get No Where Near It!!



# View the degree of heat coming from various components, all in a single image



## Fluke Infrared Cameras

- Equipment remains operational
- Captured at a safe distance increasing safety
- Live voltage still requires full electrical safety precautions
- Access components and systems not otherwise measurable, such as ceiling runs
- Help detect imminent failures in nearly all types of equipment
- Uncover potential problems in areas that would typically be ignored



Most equipment's failure mechanisms involve a significant rise in operating temperature long before catastrophic failure occurs

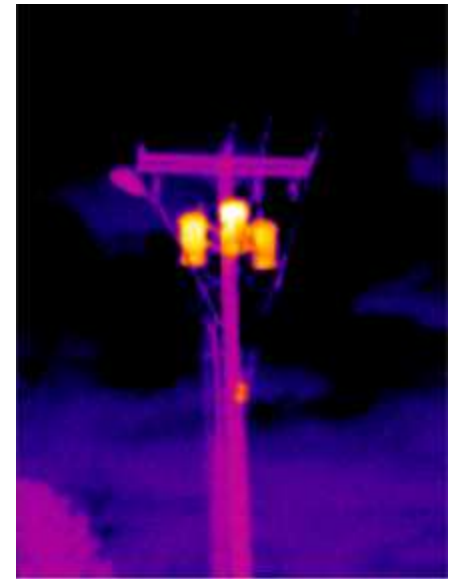
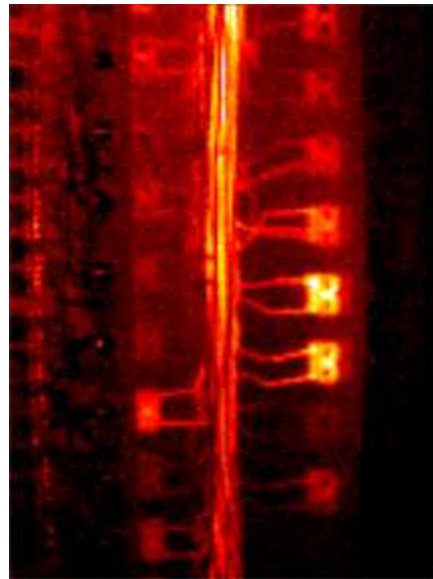
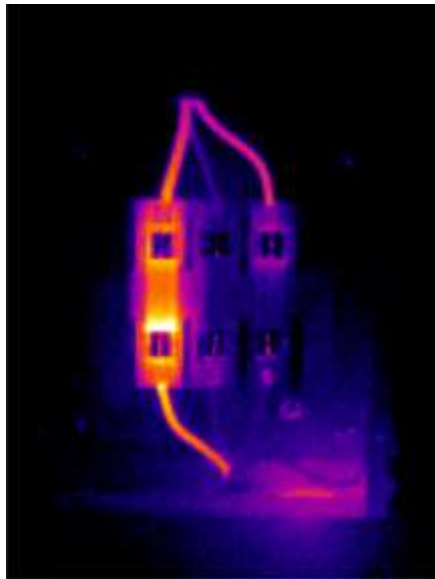
# Analyze the invisible with Infrared

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**Abnormal heating associated with high resistance or excessive current flow is the main cause of many problems in electrical systems**

- Troubleshoot problems in electrical connections
- Detect high resistance loose connections
- Check for unbalance in 3-phase electrical systems
- Balance branch loads and identify excessive current consumption



# Inspect indoor or outdoor switchgear and panels safely

An IR window can help increase the safety of personnel and reduce the cost of predictive maintenance, in compliance with switchgear codes.



# Test instrument training and proficiency



**NFPA states that “Employees shall be trained to”:**

- Select an appropriate test instrument for a given task
- Demonstrate how to use a test instrument
- Interpret results
- Understand ratings of the test instrument
- Perform a visual inspection of the test instrument and accessories
- Perform an operational verification on a known voltage source
- Identify misapplication



# Next steps: Test Equipment Safety Audit



1. Complete the on-line training course for electrical measurement safety
2. Match you working environment to the CAT rating of your tools
3. We can help Audit your test tool inventory
  - Ensure compliance with industry ratings and standards
  - Verify the operational readiness of your tools
  - Order spare parts where appropriate
4. Make training and briefings part of your daily work

## Meter Scorecard

Tested & certified by two or more independent labs	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Visual inspection of tester for cracks or faded display	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Visual inspection of test leads for cracks, CAT rating, etc	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Test lead continuity	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Rated CAT III 600 or 1000 volt or CAT IV 600 volt	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Tester is double insulated	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Ohms and continuity circuit protection	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail
Tester has appropriate fuses and they are working	<input type="checkbox"/> Pass	<input type="checkbox"/> Fail



# Thank you!



## Electrical Measurement Safety

Your right to be  
concerned

[www.TEquipment.NET](http://www.TEquipment.NET) [www.fluke.com/safety](http://www.fluke.com/safety)

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