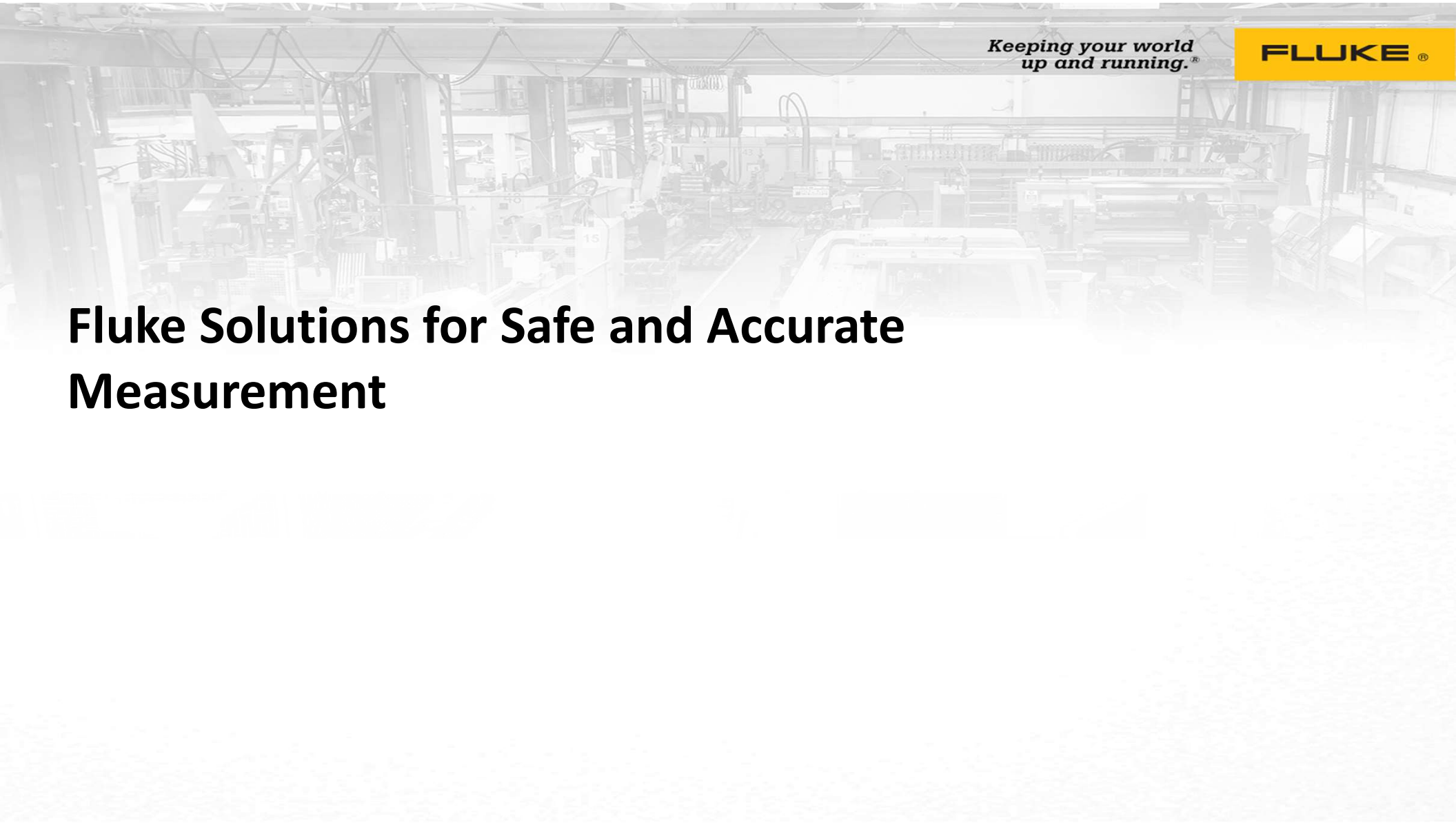


Fluke Solutions for Safe and Accurate Measurement

Safety

*"Every **15 seconds**, **a worker dies** from a work-related accident*

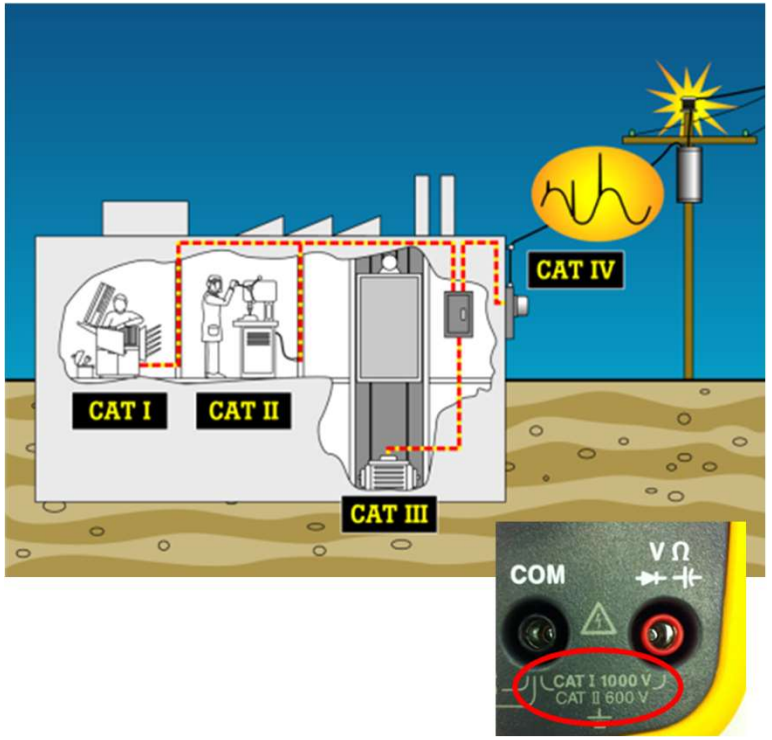
*Every **15 seconds**, **153 workers** have **work-related accidents**"*

International Labour Organization

Electrical Measurement Safety

IEC 61010 defines four Category locations

- **CAT IV "Origin of installation" - Utility level and any outside cable run. Eg: three phase at utility connection**
- **CAT III Distribution wiring, including "mains" bus, feeders and branch circuits; permanently installed loads. Eg: MC panels**
- **CAT II Receptacle outlet circuit; plug-in loads. Eg: TV, home appliances**
- **CAT I Protected electronic circuits. Eg: electronic equipment**



Risk of Arc Flash

When you are not using the right tools with the correct safety category rating:

- Human and equipment damage
- Causes severe burns
- Sometimes fatal
- Equipment damage

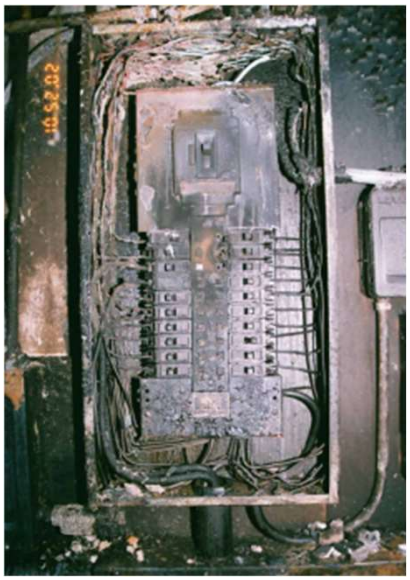
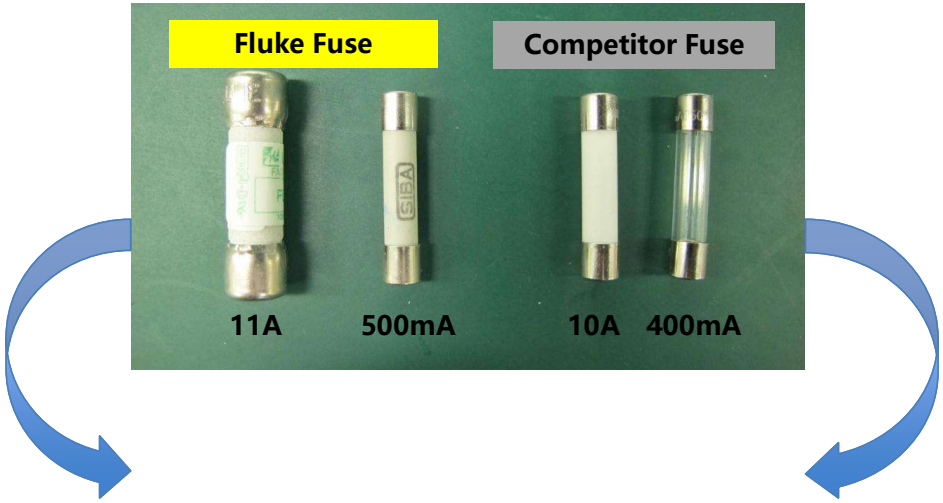


Figure 1. Demonstration of the power of an Arc Flash.
Photo courtesy of ewbengineering.

High Quality Fuse to ensure High Safety



- Made with ceramic
- Higher quality and material cost is expensive
- Voltage rating at 1000V to ensure safety even under operational errors
- 11A fuse has a breaking capacity of 20kA that can promptly disconnect fault current during a short circuit

- Made with glass, less reliable
- Voltage rating at 250V, unable to ensure safety when operational errors happen
- 10A fuse has a breaking capacity of 6kA; unable to meet short circuit requirement and serious accidents could occur

High Quality Test Leads to ensure High Safety

Safety rating is not only meant for the test meters, end users should also carefully consider it on the test leads that are being used!

Fluke has upgraded most of its test leads to meet Cat IV standards.

In addition, most of Fluke test leads has a shrouded connector which protects the user from coming in contact with the connector should it become disconnected while still attached to the circuit.

Why Fluke?

IEC is an international standard used as a guideline or reference for all electrical and electronic related technologies. It is not enforced or mandatory for all suppliers or vendors to comply.

Third Party Verification:

Only when a product is being verified by a third party that it complies to the standards, then the product is considered complied.

C SP US	Canadian Standards Association
TÜV SÜD	Technischer Überwachungs Verein (German inspection and product certification body)
CE	European Conformity
UL	Underwriters Laboratories, Inc. (US Safety Consulting and Certification company)
N10140	Austrialian Standards
VDE	VDE (Europe's technical scientific association)

What is true-RMS?

True-RMS (Root Mean Square) is a method of measuring the effective value of an alternating current (AC) or voltage waveform. It provides the equivalent DC value that would produce the same amount of power in a resistive load as the AC waveform being measured. True-RMS measurement is particularly important for accurately measuring non-sinusoidal waveforms, which are common in modern electronic systems

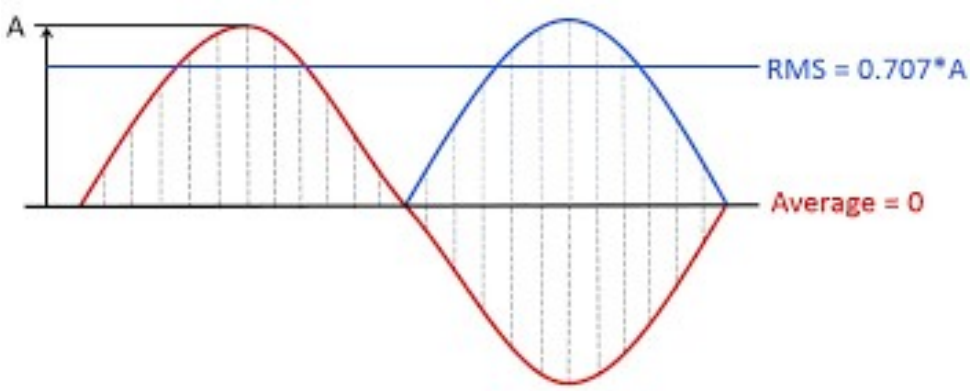
A **true-RMS** device (RMS = root mean square) is one of three tools that can measure alternating current (ac) or ac voltage:

1. True-RMS digital multimeters (or clamp meter)
2. Average-responding digital multimeter (or clamp meter)
3. Oscilloscope

Only the first two tools are commonly used, and both can accurately measure standard (pure ac) sinusoidal waveforms.

Yet a true-RMS meter is widely preferred because it is the only one that can accurately measure both sinusoidal and non-sinusoidal ac waveforms.

- **Sinusoidal (sine) waves**: Pure, without distortion, with symmetrical transitions between peaks and valleys.
- **Nonsinusoidal waves:** Waves with distorted, irregular patterns—spikes, pulse trains, squares, triangles, sawtooth and any other ragged or angular waves.



How to Measure True-RMS

- As mentioned previously, **RMS = root mean square.** Though its formula can be challenging to grasp, RMS essentially **calculates the equivalent direct current (dc) value of an ac waveform**. More technically, it determines the "effective," or dc heating value, of any ac wave shape.
- An **average-responding meter** uses averaging mathematical formulas to accurately measure pure sinusoidal waves. It can measure non-sinusoidal waves, but with uncertain accuracy.
- A more sophisticated **true-RMS meter** can accurately measure both pure waves and the more complex non-sinusoidal waves. Waveforms can be distorted by nonlinear loads such as variable speed drives or computers. An averaging meter attempting to measure distorted waves can be up to 40% low or 10% high in its calculations.

Multimeter type	Response to sine wave	Response to square wave	Response to single phase diode rectifier	Response to 3 ∅ diode rectifier
Average responding	Correct	10 % high	40 % low	5 % to 30 % low
True-rms	Correct	Correct	Correct	Correct

Where to measure True-RMS?

The need for true-RMS meters has grown as the possibility of non-sinusoidal waves in circuits has greatly increased in recent years. Some examples:

- Variable-speed motor drives
- Electronic ballasts
- Computers
- HVAC
- Solid-state environments

In these environments, current occurs in short pulses rather than the smooth sine wave drawn by a standard induction motor. The current wave shape can have a dramatic effect on a current clamp reading. In addition, a true-RMS meter is the better choice for taking measurements on power lines where ac characteristics are unknown.

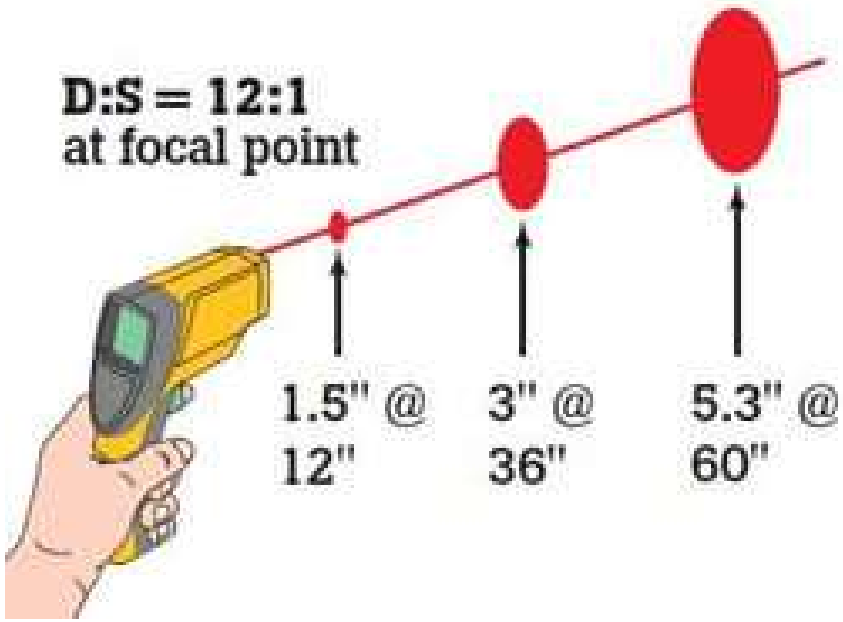
How to get great results with an infrared thermometer

Infrared (IR) thermometers enable you to measure temperature quickly, at a distance, and without touching the object you're measuring. They are so useful, easy, and even fun to use that they have become as common in kitchens as they have on factory floors. Infrared thermometers are often used to find overheated equipment and electrical circuits, but they have hundreds of other uses.

Measuring More Than You Thought?

Every infrared thermometer has a "distance-to-spot" (D:S) ratio that tells you the diameter of the area being measured compared to the distance from the target. For example, if your thermometer has a distance-to-spot ratio of 12:1, it measures an approximately one-inch-diameter spot when it's 12 inches from the target (about 2.5 cm at 30 cm).

Distance-to-spot ratios vary a lot (from about 1:1 on the least expensive thermometers to about 60:1 on top-of-the-line models) and vary slightly with distance, so be sure to check the label on your thermometer or in the manual



Lead Astray by the Laser?

Most handheld infrared thermometers have laser pointers that show the approximate center of the measurement area. It's important to know that the laser is only a pointer and not used for the actual temperature measurement.

Another common misconception is that the thermometer is measuring the area illuminated by the laser beam. The measurement spot is always wider.

Confused by Bright Shiny Objects?

Infrared thermometers have good accuracy when measuring most objects, but shiny, reflective surfaces can be a challenge. You should be especially wary when measuring the temperature of shiny metal objects, but even reflections off of glossy paint can affect accuracy. Putting a piece of non-reflective tape (such as electrical tape) over the shiny surface or applying some flat paint gives you a target from which you can get a better measurement.

The reason for this is that not all materials emit the same amount of infrared energy when they are at the same temperature. In general, most materials emit more infrared energy than shiny metals do - they have higher "emissivity." (Emissivity is expressed as a number between 0 and 1, with 0 being non-emissive and 1 being perfectly emissive).

If you need to take temperature readings on low emissivity objects regularly, consider an IR thermometer that enables you to compensate for variations in emissivity.

Obscured Optics and Temperature Shocked

Where you use your infrared thermometer can also affect its accuracy. For example, if there is steam or dust in the between the target and the thermometer, some of the IR energy may be deflected before reaching the thermometer.

Finally, for highest accuracy, it's best to allow some time (about 20 minutes is usually enough) for your IR thermometer to come to the temperature of its surroundings when bringing the thermometer into surroundings that are significantly warmer or colder than where it has been stored.Noncontact infrared thermometers offer a great combination of speed, convenience, and accuracy, but only when they're used correctly.

Fluke HVAC Solutions

Fluke 971: Temperature Humidity Meter

Maintaining optimal comfort levels and ensuring good indoor air quality are critical, necessitating precise temperature and humidity control. The Fluke 971 stands out as a premier solution, adeptly serving as both a temperature humidity meter and a dedicated humidity tester.

Fluke 922 Airflow Meter/Micromanometer

Today's HVAC technicians want a simple solution for diagnosing ventilation issues. Technicians also want to measure air velocity measurements and flow, without having to resort to expensive, difficult to use, specialist tools. The Fluke 922 makes airflow measurements easy by combining three tools: differential pressure, airflow, and velocity into a single, rugged meter.

Fluke 116 HVAC Multimeter with Temperature and Microamps

The Fluke 116 HVAC multimeter was specifically designed for HVAC professionals. It has everything you need to quickly troubleshoot problems with HVAC equipment and flame sensors, including a built-in thermometer to measure temperatures up to 400°C (752°F) and microamps to test flame sensors

Fluke 985 Particle Counter

The Fluke 985 Particle Counter is the preferred choice for HVAC and IAQ professionals. From filter testing to IAQ investigations, the Fluke 985 is the portable solution for determining airborne particle concentrations. Use the Fluke 985 to immediately respond to occupant complaints, or as part of a comprehensive preventive maintenance program.

FLUKE®

THANK YOU!