

Shocking treatment

Application Note

Safer by design

How would you like to be dropped on your head, shocked, short-circuited, injected with thousands of volts of electricity and forced to endure extreme temperatures, all before you get out the door? **Ouch.**

Yet Fluke Corporation's test tools go through all that and more before a new Fluke product arrives in your toolbox. Once a new product survives Fluke's equipment test labs, you know it has what it takes to survive in the wilds of your world.

"Our charter is to make sure that no Fluke product will ever fail in a customer's hands," says Bruce Maier, a Fluke safety engineer who has spent more than two decades working on electrical test instruments. Maier is one of five test engineers on the Fluke product evaluation team that performs a withering list of safety, environmental, and reliability tests, all designed to make sure your Fluke test equipment works safely, efficiently and reliably.

You likely already know that many Fluke digital multimeters (DMMs) come with a lifetime warranty, an exclusive quality guarantee that no other vendor offers. But thanks to Fluke's obsession about quality, you probably haven't had to use it. The ultimate objective of Fluke's abusive testing is to have our customers using Fluke products that will survive anything they can dish out, and then some.

There's a serious intent behind all the mayhem. The potential for injuries or deaths when using test instruments is very real. Electrical workers are

killed or injured by shocks and burns each year. Even in less serious incidents, workplace accidents result in a median of three days off work.

As the tragedies behind those figures show, improper use of test equipment can have dangerous — and sometimes fatal — results. Because of Fluke's commitment to safety, all of its equipment is designed to give a bit of extra cushion in case of operator error and provide as much protection as possible from the inherent dangers of working in the unsettled sea of electricity.

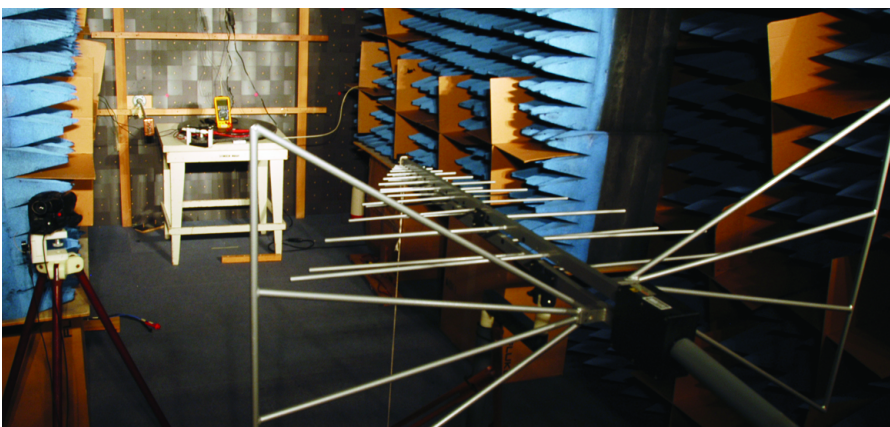
Laboratory fireworks

Fluke product evaluation teams spare no meter the full force of a comprehensive battery of tests. Fluke engineers test more than 20 products a month for robustness and safety under the worst possible conditions.

One test, called an impulse test, simulates a lightning strike. A meter is placed in a chamber and injected with thousands of volts of electricity. Maier and his colleagues take the meter through significantly more than your meter is designed to measure to protect you against the effects of a dangerous electrical spike or transient.



A meter, straight out of the test chamber at -4°F (-20°C), measuring 1000 V ac 1 KHz while covered with ice.



Anechoic chamber where EMC testing is conducted. The antenna in the foreground radiates radio waves at the meter shown on the back wall of the chamber.

"We set the notch just a bit higher," he says. "We design our products to exceed the conventional standards for impulse testing."

Forget suits and ties for the product evaluation team. They forego business attire for clothing that withstands a war zone. Observe the product safety testing centers, and you could get the impression that it was the Fourth of July.

"It can be a little dangerous if you're not careful around here," Maier admits. "Things have been known to blow up or spew flames."

Allowing for operator error is another factor that goes into such rigorous safety tests. For example, the multi-functional overload test involves injecting very high-energy voltage into non-voltage functions. Maier adjusts the meter inside a small chamber to every conceivable position while sending powerful voltage surges into the instrument.

Again, as in all these procedures, products are tested to destruction.

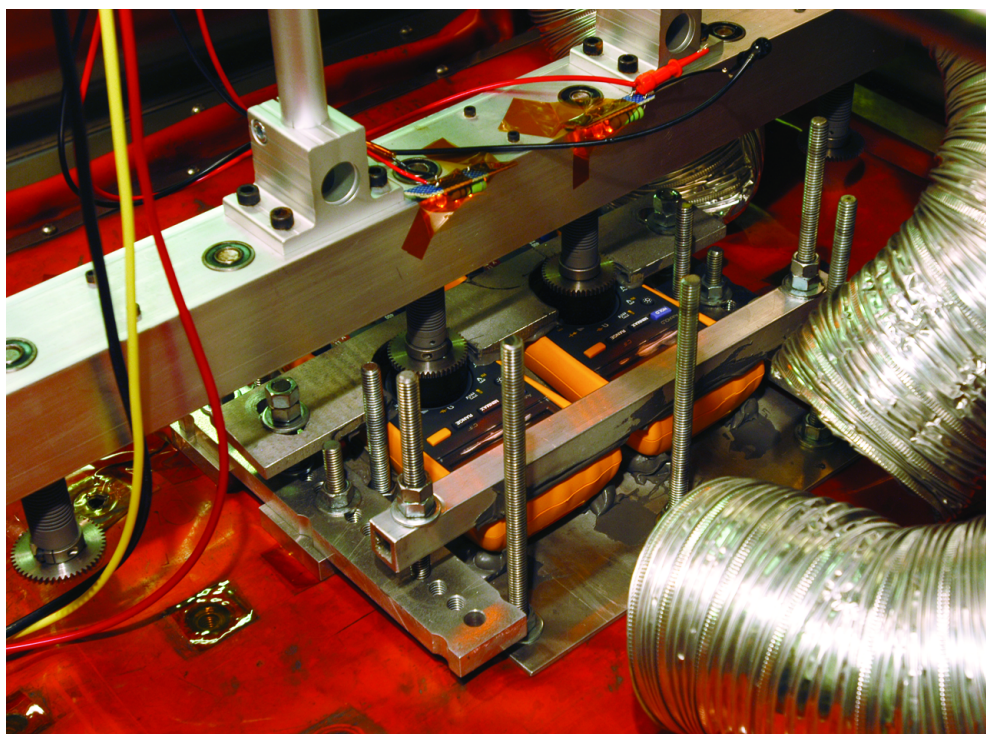
"People's lives are literally on the line, and that thought is always first on our minds," Maier says. "If a meter goes bad, it could be deadly."

There may be occasions when a user will be testing electrical equipment while conducting other tests and not want to have radio frequency waves disrupt meter circuitry. So the test engineers place meters in an anechoic chamber and transmit doses of radio frequency waves into the meter.

"A user may be using his walkie-talkie while measuring equipment, and he doesn't want the test tool to malfunction. Or an auto mechanic could experience noisy readings when working around the ignition wires. This test helps prevent these things from happening," Maier explains.

Fluke uses HALT (highly accelerated lifetime testing) to wring out new designs. This combines 3-axis vibration at more than 150Gs with extremely fast temperature swings to simulate a lifetime of wear and tear. The chamber has the capability of going from -100 °C (-148 °F) to 200 °C (+392 °F) in minutes.

"The saying with this test is, 'shake and bake it till you break it,' " Maier says with a smile. "Then make design improvements to whatever broke and re-test."



View inside of the HALT chamber. Notice that the meters under test are bolted down to the shaker table so that the energy of the shaker table is transferred to the meter and that the airducts, in the foreground, are directed at the meters for more rapid heating and cooling.

Unlikely as it seems when you take a new Fluke meter out of its box and vow to keep it like new forever, electricians have been known to drop instruments onto hard surfaces. So test engineers repeatedly drop meters on all six sides several feet to a concrete floor and then inspect them for the slightest damage. This test is done at the operating extremes of the meter, at -10 °C (-14 °F) and +55 °C (+131 °F).

Another test simulates meters being transported under rugged conditions, such as in off-road vehicles. Engineers place the meter on a vibration table where it is shaken at 5Gs for as much as 30 minutes per axis. Once is not enough. Meters are repeatedly tested in several positions to account for all conceivable circumstances.

Once a piece of equipment has at last passed muster, the entire team experiences a sense of satisfaction that lasts long after the product begins shipping, Maier says.

"Once we've signed off on a product, it feels like you've given birth," he says. "It's like your kid is out there now and it's on its way to the customer. It's a good feeling."



The drop test. A meter specified to -10 to 50 °C, such as the Fluke 179, will be dropped from 1 meter on all six sides at -10 and again at 50 °C.

An electrical accident can result from something as simple as accidentally misconnecting leads or be as unavoidable as encountering a transient shock that originated a dozen miles away.

Safety tips from Fluke:

Adhere to local and national safety codes. Wear protective equipment to prevent arc blast injury. Never work alone. Train to your local code.

United States: National Fire Protection Association (NFPA). For more information go to: <http://www.nfpa.org/catalog/home/index.asp>

Canada: Occupational Health and Safety acts-federal/provincial legislation.

Read your product's operating manual. Be sure you understand how to safely operate your equipment: For example, leaving test leads in the amps input terminals and then accidentally connecting the meter leads across a voltage source creates a dangerously low impedance through the meter. Appropriate fusing is essential to avoid possible injury. The low impedance also increases the potential shock hazard in the case of accidental contact with the probe tip. Correct operating procedures short-circuit this danger.

Observe basic safety procedures when testing. Visit www.fluke.com for information on safe testing procedures. Transients, as anyone familiar with electrical currents knows, can be lethal. If a transient causes an arc-over, the high current can sustain the arc and produce a plasma breakdown or explosion. The result is an arc blast, which leads to more electrical injuries every year than even electric shock.

Use equipment rated for the test environment. Test instruments are rated for operation in four categories:

CAT I – refers to protected circuits not directly connected to the line supply.

CAT II – covers the receptacle circuit level and plug-in loads.

CAT III – covers distribution-level wiring, which includes 480 volt and 600 volt circuits such as three-phase bus and feeder circuits, motor control centers, load centers and distribution panels.

CAT IV – is associated with the origin of installation and refers to power lines at the utility connection and includes any outside cable runs for both above and underground cables.

The closer you are to the power source and the greater the current, the higher the category number and the greater the danger. It is imperative to match the rating on your test tool to the environment in which you're working. Don't get caught using a Category II DMM in a Category III system. Even the most stringently tested and designed equipment has its limits.

Expect the unexpected. Sometimes a Fluke test instrument is the only thing that stands between a user and an emergency room visit. Even a lightning strike or load switching far from a tester's job site can create a nasty jolt. That's when Fluke's built-in safety features can mean the difference between a close call and a nasty injury.

Fluke's commitment to safety is unsurpassed. Your dedication to using safe working procedures every time you conduct a test is the most important factor in keeping you safe as you can be. Safe operator practices are what Fluke's test lab engineers like to see most of all.

Fluke. Keeping your world up and running.

Fluke Corporation

PO Box 9090, Everett, WA USA 98206

Fluke Europe B.V.
PO Box 1186, 5602 BD
Eindhoven, The Netherlands

For more information call:
In the U.S.A. (800) 443-5853 or
Fax (425) 446-5116
In Europe/M-East/Africa (31 40) 2 675 200 or
Fax (31 40) 2 675 222
In Canada (800) 36-FLUKE or
Fax (905) 890-6866
From other countries +1 (425) 446-5500 or
Fax +1 (425) 446-5116
Web access: <http://www.fluke.com>

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