

Electrical tester . . . or pry bar?

Fluke mechanical designers
let users make the call.

Technology
at Work

Every day can be a battle for technicians and their Fluke tools. Through heat, dust, solvents and bleach, baked in the sun, subjected to extreme cold like an Antarctic winter or dropped down mine shafts, they stay on the job and keep producing results. Well, at least the Fluke tools do.

Like the users, the mechanical engineers who design those Fluke tools face their own daily battles. It's their job to create tools tough enough to be Flukes, but not too complex to manufacture or too expensive to afford.

They've got to anticipate that a maintenance tech in a hurry might use a plastic electrical tester to pry heavy gauge wires apart. And they've got to beef up the tester to survive it.

By sweating the small stuff, and getting a thousand tiny details right, they keep Fluke tool users from sweating the big stuff — like tools that can't get the job done.

"When you talk about ruggedness, it's more than just dropping the unit and expecting it to work," says Terry Morey, head of the Fluke mechanical engineering department. "It's how well does the ink stay on the buttons? How well does the snap on the battery door last? If the product vibrated a lot, would the battery still make connection? The list goes on and on and on."

"Every part is a 'product' we have to think about," says Brian Aikins, one of Fluke's senior mechanical engineers. "We are constantly asking ourselves 'How does this part affect the overall product performance?'"

"We see good mechanical design as extremely valuable to the customers, but it's kind of hidden," adds Morey. "And we put a lot of engineering time into making sure the product we design is safe as well as robust.

For instance, tools used to measure up to 1000 volts must meet "creepage and clearance" specs to separate a user's hand from the electricity inside the meter. The halves of most Fluke multimeters come together in complex interlocking joints that provide nearly an inch of creepage and clearance separation.

"We spend hours and hours looking at that," says Morey. "It's not just a straight shot, it's three dimensional." Complicating the job: requirements vary with changes in such factors as altitude and the amount of pollution in the environment.

Because environment makes such a difference, Aikins finds the best way to know what users need is to stand by them as they work, as he did when Fluke created the T5 electrical tester.

Into the customer's environment

"Seeing the customer's work environment provided a lot of inspiration for the whole T5 project," says Aikins. "For example, our visit to a chicken processing plant showed us that our meters must perform safely and accurately in hot, humid areas. By watching the technicians at work, we also discovered that both the test probe tips and the current sensor jaws needed significant strengthening." Watching



This DMM has been filled with resin and then sliced open, allowing Fluke mechanical engineers to see how the contact points line up.

the users work with the T5 mockups, "we were just amazed," he adds. "One technician actually broke our mockup by using the current sensing jaws to pry apart a group of heavy gauge wires. Now those jaws can take a 5/8 inch rod forced into them without breaking, and still measure as accurately as ever."

Extra durable

Having seen that techs might employ the tester as a pry bar, the Fluke team made it extra durable. Four beefy screws hold the shell together and make the tool rigid enough to withstand such abuse. Screws cost more than glue, but they're easier to deal with on the assembly line, and they are tough.

Back at headquarters, Fluke engineers combine Computer Aided Design (CAD) and sophisticated finite-element analysis with the hands-on approach. A pair of rapid prototyping machines can quickly convert a CAD drawing into a model made of gypsum or plastic that the engineer can hold and study.



Fluke mechanical engineers create these see-through prototypes so they can watch the effects of twisting, prying, and shaking on the tool's innards.

"Looking at a picture isn't nearly as good as holding it in your hand," says Aikins. "The feedback you get from a prototype is much more in-depth. I think it's easier to see the strengths and weaknesses from a real object than from a computer screen."

The prototype helps engineers understand complex parts like a plastic case. "We try to make every plastic part do as many things as possible," Aikins says. "A top case could have creepage and clearance features, mounting features for the circuit board and connection features for the shield and battery. The interior is usually very complicated, while the outside is designed to look simple and clean."

Rather than risk redesigning every part of a tool at once, Fluke engineers spread design improvements from model to model. An improved rotary switch created for one digital multimeter (DMM), for instance, becomes the standard for future models. The next DMM may use the improved switch and add redesigned, tougher test lead receptacles. The result is tools that grow tougher with each revision – truly tough tools.



This battery contact test board tests different material combinations, including wire thickness, contact pad metal composition, and lubrication requirements. The goal: the strongest electrical connection to the battery.

On a credenza by his desk, Aikins has proof.

Burned, beaten and blasted

There in a row lie some truly gnarly Fluke tools. Burned, beaten and blasted, but proud, they have war stories to tell. Aikins speaks for them.

He gestures at a DMM with a decidedly sunburned look. "This meter I left up on the roof, to see how it would last," he says. "After three years, it still worked."

Beside it, a meter that looks a little like The Blob. "A tech had this one on his ladder while he worked on an industrial oven," Aikins recounts. "He fired up the oven and forgot to close the door – he was working on the other side. It melted the ladder and the meter, but after I changed the battery, I was surprised to see that the meter still worked!"

"This meter here fell into a cement mixer and got tumbled in the cement. The guy opened it up—it was totally full of cement on the inside—they hosed it off and dried it, and it was still working."

Clearly proud, Aikins places the scruffy meter back with the others.

It was Fluke Tough. Its battle is done.

For more information about Fluke tool design, visit www.fluke.com/tough.

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